HEATING & VENTILATING

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

Volume 32 | DECEMBER, 1935 | Number 12

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Published Monthly by

THE INDUSTRIAL PRESS, 148 LAFAYETTE STREET, NEW YORK

WESTERN OFFICE: 228 NORTH LA SALLE ST., CHICAGO

ROBERT B. LUCHARS, President
EDGAR A. BECKER, Vice-Pres. and Treasurer
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Subscription, $2 per year in United States and Mexico. $2.50 in Canada. $3 all other countries. Single copies regular issue, 30 cents.

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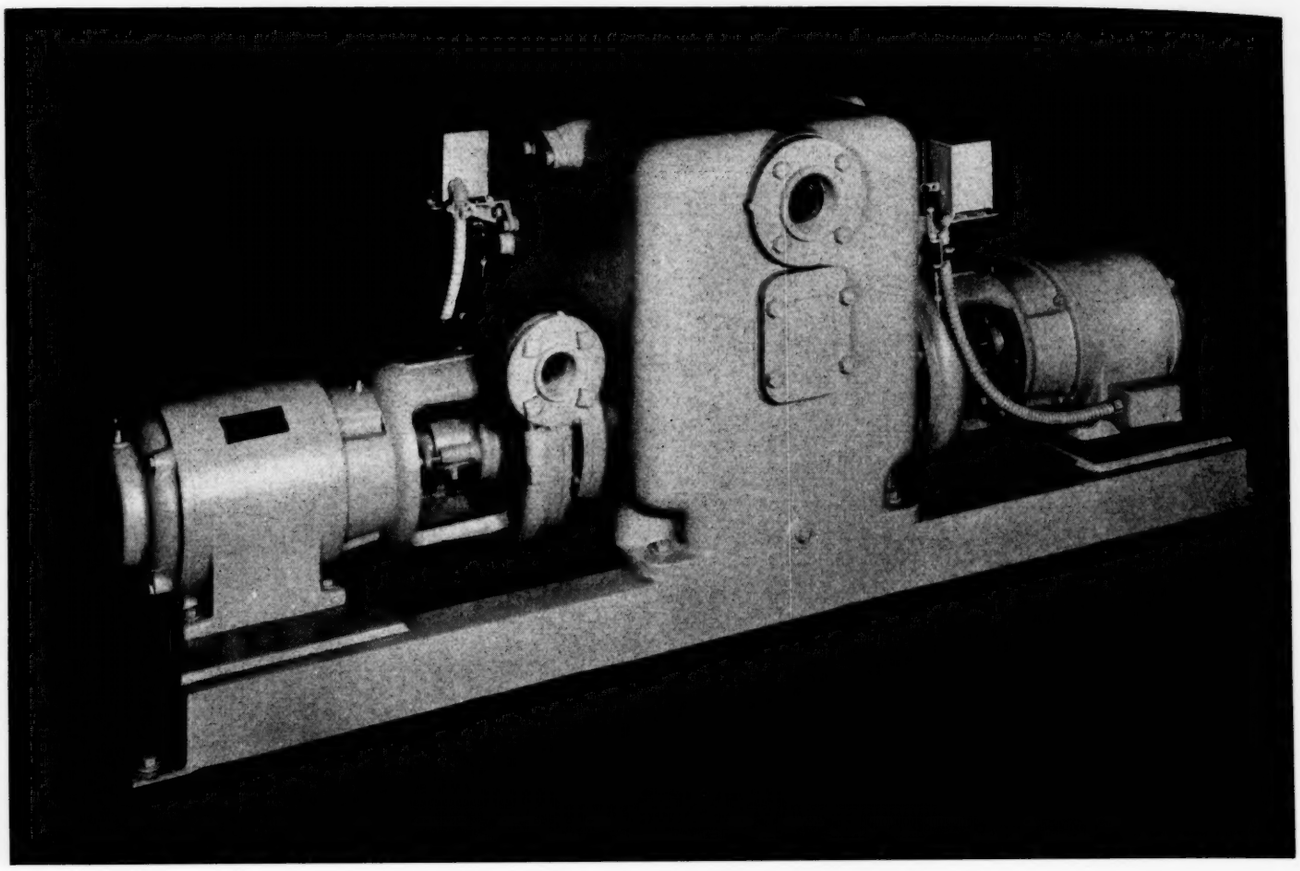

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THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

A Problem in Selecting and Locating Unit Heaters

EVERY heating engineer is more or less frequently confronted by problems involving the selection and location of unit heaters. It is very infrequently, however, that he has the opportunity to compare the practicability of his judgment on a given problem with the carefully considered opinions and decisions of specialists in unit heater applications.

The recent contest conducted by Modine Manufacturing Company presents such an opportunity.† Since the problem was clear cut in its presentation, involves many points common to a wide range of unit heater problems, and since the solution can be easily followed through in a logical and systematic manner, it is described here in some detail.

The solution presented might be designated as ideal, since it follows with only a few minor variations the one considered best by the company's engineers who are working constantly on unit heater problems.

The Problem

The problem was to select the proper models of Modine steam unit heaters which would best heat the building (which is a bus garage, repair shop, and small office) and at the same time give sound performance and reasonable economy in both installation and operating costs. A plan and elevation are shown in Fig. 1, but the original drawing did not show unit heaters spotted in as they are in Fig. 1. No heat losses needed to be computed as they were given and no piping connections had to be worked out or indicated on plans.

The building is divided into three parts: one to accommodate bus storage, another for repairs, and a third the office. The heat losses of these three departments were 450,000, 550,000 and 120,000 B.t.u. per hr., respectively, and the temperatures to be maintained with zero outside weather were 50°, 60°, and 70°, respectively. Available steam pressure was 2 lb. and the electric current was 110 v., 60 cycle, single phase. Motors selected could be either constant or two speed.

The Solution

One of the requirements was that the unit heaters should be selected from the company's catalog No. 535. In order to show this information in condensed form, Table 1 has been prepared to show the capacities of all stock models of the company's line covered in the catalog, at entering air temperatures specified for the three departments, and for both first and second speeds. In addition, it gives the horsepower of the motor, fan diameter, the motor r.p.m. at first and second speeds, and the list price with a constant speed or two-speed motor.

From Table 1, and with the requirements of the problem in mind, it is possible to group the units into all possible reasonable combinations for the three different departments and reduce the number of possibilities to a relatively few. This has been done in Table 2, which shows, for example, that there are five different combinations of units which will give the necessary capacity of 450,000 B.t.u. per hr. for the storage space where the entering air temperature is 50°. This has been done also for the repair shop and the office and reduces the possible combinations for the whole job to ten in number.

The selection of the heaters for a given space can then be made on the basis of:

1. Arrangement for heating results,

P. A. Edwards, left, receives the $200 prize check from P. F. Moser, Pittsburgh representative of Modine.

†The grand prize of $200 in the contest was won by P. A. Edwards, of the G. F. Higgins Company, heating contractor, Pittsburgh. Mr. Edwards is a graduate of Carnegie Tech, and one of his most notable accomplishments was his work on the heating system of Duquesne University which was designed and installed by his firm. At the present time he is engaged with his firm in installing a heating system in the University of Pittsburgh Cathedral of Learning.

The winner's solution was almost identical with the ideal solution outlined here.

Runners-up to Mr. Edwards in the contest were W. W. Hughes, of Minneapolis, and P. Abrahamson, of Chicago, both of whom received awards of $50 each.

Judges in the contest were J. Lawrence De Neille, president of the Heating, Piping and Air Conditioning Contractors National Association; W. W. Gothard, managing editor of *Domestic Engineering*, and C. H. B. Hotchkiss, editor of HEATING & VENTILATING.

The contest called not only for the selection of the unit heaters and locating them on the floor plan, but an outline of the reasons why the certain models were selected, why they were located as they were, and why the air stream was directed a certain way.

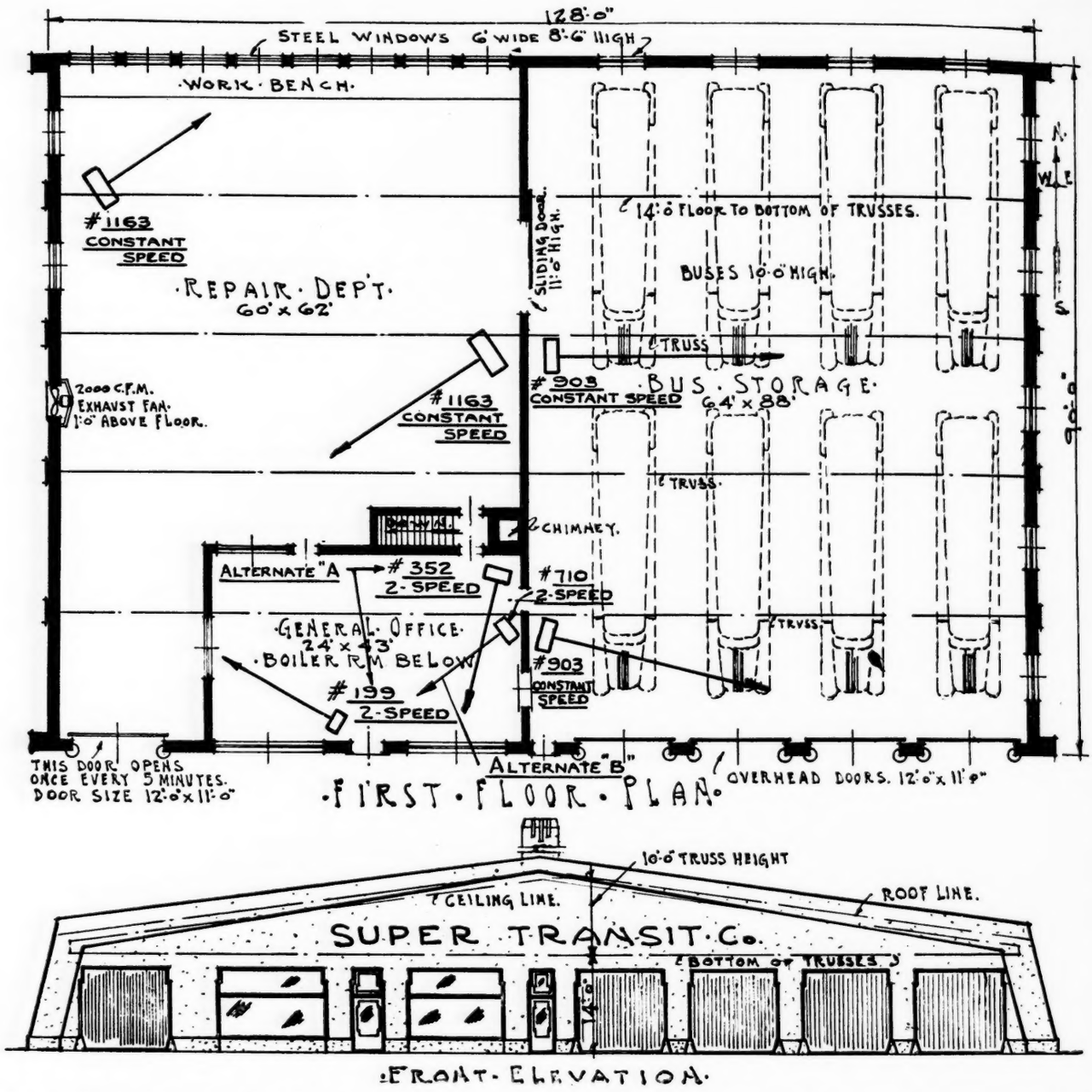


Fig. 1. Plan and elevation of the bus garage to be heated with unit heaters. Unusual conditions, such as location of exhaust fan, open doors, etc., are shown. Locations of heaters, as described in the solution, are also shown.

2. Arrangement for economical piping,
3. First cost of heaters,
4. Operating cost of heaters (which, in general, would be in proportion to the horsepower of the motor), and
5. Quietness of operation (which would be roughly inversely proportional to the diameter of the fan and the r.p.m. of the motor).

Bus Storage Space

The important place where heat is desired in the storage space is around the bus motors, especially when these are adjacent to the front doors. It is important to avoid direct blowing of heated air against the bus sides and tops, since the bulk of the bodies would interfere with the easy flow and distribution of the heated air. There is no good reason for using a two-speed motor in this space since constant speed motors are satisfactory and lower in price.

Referring to Table 2, Combinations A to F, inclusive, Combination A can be thrown out on the grounds of using too many units, with consequent high piping costs and having too high a first cost for heaters. For similar reasons Combination D can be thrown out. Combination E calls for only one unit heater which would probably have difficulty in distributing its air through the whole space, and in addition would have a high operating cost since it is equipped with two ½-hp. motors. This leaves for consideration Combinations B, C, and F. Of these three, Combinations B and F are higher in cost than Combination C, and in the case of B, which calls for three unit heaters, the piping would be more involved and probably more expensive than a combina-

tion using two unit heaters. Furthermore, with Combination F we have one unit heater of one size and one of another which would not give as even a distribution as two of the same kind. Consequently, due to low cost of heaters, even heat distribution, and low installing cost, Combination C, consisting of two No. 903 units at constant speed, would be selected.

These would be located as shown in Fig. 1 for the following reasons:

(a) To deliver the heated air across the motor hoods of the buses to keep the motors warm for easy starting in very cold weather, and to avoid blowing heated air directly on the bus bodies, with possible injurious effect to the bodies; to give delivery of heated air the clearest possible path, locate the heaters facing the motor hoods;

(b) Locate the units against a wall in order to give the most complete headroom above the buses as regards traps and return piping, and

(c) Locate against the west wall because the units are thus nearest the boiler and hence most economical of pipe; also because the units are thus blowing toward the exposed walls.

TABLE 1. CONDENSED TABLE OF DATA ON MODINE UNIT HEATERS UNDER CONDITIONS OF PROBLEM

Model Number	Entering Air Temp., Deg.	Capacity In B.t.u. Per Hr., At High Speed	Capacity In B.t.u. Per Hr., At Second Speed	Motor Rating, Hp.	Fan Diameter, In.	Motor R.p.m. At 1. High Speed 2. Second Speed	List Price With 1. Constant Speed 2. Two Speed Motor
76	50 60 70	19,370 18,240 17,080	17,300 16,300 15,250	(6 watts output)	8	1. 1,550 2. 1,200	1. $36.70 2. 37.40
152	50 60 70	38,800 36,500 34,200	34,600 32,500 30,400	1/40	12	1. 1,590 2. 1,350	1. 62.80 2. 66.10
199	50 60 70	50,750 47,800 44,700	41,900 39,500 37,000	1/20	11¾	1. 1,120 2. 850	1. 72.60 2. 78.40
238	50 60 70	60,900 57,200 53,600	50,500 47,400 44,400	1/20	12	1. 1,140 2. 850	1. 77.80 2. 83.70
352	50 60 70	89,750 84,400 79,100	71,000 66,750 62,500	1/10	13	1. 1,140 2. 850	1. 87.80 2. 95.20
440	50 60 70	112,200 105,600 99,000	92,700 87,150 81,700	1/10	15	1. 1,140 2. 850	1. 93.60 2. 101.40
542	50 60 70	138,200 130,000 121,900	112,000 105,400 99,000	1/8	17	1. 1,125 2. 850	1. 102.70 2. 113.10
710	50 60 70	181,000 170,300 159,300	150,000 141,300 132,000	1/6	19	1. 1,120 2. 850	1. 124.30 2. 134.20
903	50 60 70	230,500 216,600 203,000	189,000 177,700 166,500	1/4	21	1. 1,125 2. 850	1. 158.10 2. 166.80
1,163	50 60 70	296,500 279,100 261,500	— — —	1/2	22	1. 1,110 2. —	1. 203.70 2. —
1,545	50 60 70	394,000 370,800 348,000	336,000 317,000 297,000	Two, 1/4 each	Two, 21	1. 1,125 2. 850	1. 270.70 2. 285.50
2,015	50 60 70	513,000 483,500 452,500	— — —	Two, 1/2 each	Two, 22	1. 1,110 2. —	1. 353.00 2. —

Repair Shop

Combinations G and H are so close to each other in cost as to make little difference from this standpoint. As to operating cost, however, Combination H will be higher since it has a total of 1-hp. motor as against slightly over ½ hp. for Combination G. Combination G with three units would have higher installation costs due to running the piping a greater distance. Consequently, the two No. 1163 units (Combination H) seem to be the reasonable choice. The heaters should be located as indicated in Fig. 1 for the following reasons:

(a) One unit should wipe the north wall, along which work benches (to obtain best working daylight) are located. This one unit could be placed opposite the location shown in Fig. 1 (that is to say, on the partition wall just north of the doorway leading to the storage space). If this were done, though, the second unit would have to be located in such a way that its heat delivery would be toward a partition wall and hence less effective than when directed toward an outside wall. This statement is predicated on the theory of it being advisable to set up a generally circular motion of the air in a space to be heated with unit heaters.

The second unit is located to complete and to balance the generally rotating circulation of heated air in the repair department. It blows toward an outside wall, as it should. It heats an area which will doubtless be actively used even though not as much so as the space immediately adjacent to the work benches. It avoids direct delivery of heated air into the exhaust fan and avoids emission of heated air in the immediate vicinity of the exhaust fan. A unit located very close to the exhaust fan would probably have its delivered heated air short circuited, with waste of heat;

(b) The street entrance to the repair department has a door which opens an average of each five minutes but the space leading to it is only sufficiently wide to allow its use *as an aisle* for cars entering and leaving. Therefore, there is no point to heating this aisle to any great extent. Moreover, cold air entering this main door when the door is opened will to a large degree be picked up at once by the exhaust fan. The only possible necessity for heat in this aisleway would be to protect the west office partition from exposure to low temperatures. This is not important because that wall contains no doors, and because that wall can be warmed by the unit or units to be installed in the office. Finally, the unit

TABLE 2. POSSIBLE AND REASONABLE COMBINATIONS OF UNIT HEATERS TO MEET REQUIREMENTS OF SPACES TO BE HEATED

Space To Be Heated	Combination	Number And Models of Units	Total Heat Capacity At Required Air Temp., B.t.u. Per Hr.	Total Motor Hp.	Total Cost
Storage Space (450,000 B.t.u. per hr., Ent. air temp., 50°)	A	Three No. 542 One No. 152	453,400	3/8 + 1/40	$370.90
	B	Two No. 542 One No. 710	457,400	1/4 + 1/6	329.70
	C	Two No. 903	461,000	1/2	316.20
	D	Three No. 710	443,000	1/2	372.90
	E	One No. 2015	513,000	1	353.00
	F	One No. 1163 One No. 710	477,500	1/2 + 1/6	328.00
Repair Shop (550,000 B.t.u. per hr., Ent. air temp., 60°)	G	One No. 903 Two No. 710	557,200	1/4 + 1/3	406.70
	H	Two No. 1163	558,200	1	407.40
Office (120,000 B.t.u. per hr., Ent. air temp., 70°)	I	One No. 352 One No. 199	123,800	1/10 + 1/20	173.60†
	J	One No. 542	121,900	1/8	113.10†
	K	One No. 710	159,300	1/6	134.20†

†Price with two-speed motors

directed as indicated in Fig. 1 toward the northwest corner of the office will give heat to this aisleway to a degree sufficient to protect the southern end of the repair space from any possible drafts up the aisle.

(c) The supply branch leading to the heater on the west wall of the repair department can be easily run above the bottom chords of trusses and thus the height of return line can be kept well above a level of 10 ft. for clearance purposes, without the expense of trenching for the return line from this unit.

Summarizing the advantages of this selection in the repair department, the two units will serve the demand of even heat distribution with low cost; the work bench will be well supplied with heat; no heater will be located so that it will blow directly at the exhaust fan, and none will be located above the exhaust fan.

Constant speed motors suffice for shop purposes and are employed for reasons of economy.

Office

This department is the only one of the three where quietness of operation is a point. Most of the time the second speed of a two-speed unit will be sufficient to heat the office with additional capacity available for the coldest weather. The extra speed also allows the easy control of the volume being delivered, an important factor in a small place. For this reason, then, Combination J, which consists of only one No. 542, is not considered, since it has just sufficient capacity at high speed to heat the room, and with its 17-in. fan would be noisy for an office. On the other hand, Combination I, although the highest priced, has units which operate at less than 1,200 r.p.m., and neither of the fans is over 13 in. in diameter, so that this combination would be quiet. It will be noticed from Table 1 that Combination K, consisting of one No. 710, will meet the requirements at second speed. Consequently, either Combination I or K could be selected for this department. The two units would give less drafts.

Combination K can be used and No. 710 heater involved in this combination located as shown in Fig. 1 for the following reasons:

(a) The unit is directed to wipe the front or principal exposed wall, and

(b) Air movement from this unit is sufficient to wipe the partition wall of the office, separating the office from the repair department entrance aisleway.

The one large unit operating on the second or lower of its two speeds will give the required heat, will distribute this heat reasonably well, and will operate fairly quietly. It is lower in equipment and installation cost than the two units in Combination I.

If Combination I is used (consisting of Nos. 352 and 199) they would be located as shown in Fig. 1 (designated as alternate A on the drawing) for the following reasons:

(a) For reasonable quietness;

(b) Larger of the two units is directed toward the principal exposed wall at an angle such that the air stream will not mushroom back on itself but will still wipe the wall;

(c) Smaller unit directed toward interior partition wall which is actually an exposed wall by reason of the comparatively unheated aisleway adjacent to it, this aisleway being chilled intermittently by opening of the large entrance door, and

(d) Units can be located anywhere along the office walls without regard for piping difficulty inasmuch as the space below the office is excavated and return branches from the units can therefore be dropped at any point down through the floor.

Cheap Shop Heat from Diesels

EFFECTIVE utilization of the heat in diesel jacket water makes it possible for Rockford Screw Products Co., Rockford, Ill., to heat its shop for almost nothing. Plant power equipment includes two 210-hp., and a 60-hp., six-cylinder, diesel generator sets, all Fairbanks-Morse units. The first unit was installed in 1932 when the plant was new, the second in 1933 to meet increasing load. Since the plant operates three 8-hr. shifts, load factor is excellent. With both large engines operating at their peak, slightly over 1,000,000 B.t.u. are available in cooling water. This heat is recovered in six unit heaters disposed around the one-story, glass-walled factory, each with motor-driven fan and two sets of thermostatically operated louvers, one opening outside, one into the plant. Since the heaters serve to cool engine water as well as heat the plant, the fans operate continuously, excess heated air being bypassed outside the building. The thermostats are set for 68°-70°, and held that temperature all last winter. On Sunday three small oil-fired hot water boilers take care of necessary heating, while the 60-hp. diesel supplies power. Operating cost of the plant is less than $0.005 per kw-hr. even without allowing credit for the heat, which would further reduce the cost.—*Power.*

Standards for Testing and Rating Air Conditioning Units Completed and Approved

CULMINATING work begun almost a year ago Standards for Rating and Testing of Air Conditioning Equipment were approved by the Air Conditioning Manufacturers' Association October 11, 1935. Together with a sister code on Standards for Testing and Rating Mechanical Condensing Units, the codes were written and rewritten several times, the committee holding nine meetings this year alone so as to complete the work expeditiously in order that these rating methods could be put into execution as soon as possible.

In 1931 the American Society of Refrigerating Engineers organized the Committee on Extending the Standard Ton of Refrigeration, this committee consisting of three representatives from ASRE, three from the Refrigerating Machinery Association, and three from National Electrical Manufacturers Association. At the spring convention of ASRE in 1934, RMA requested that the joint committee's scope of activities be extended to include the rating and testing of air conditioning equipment. At the same time the name was changed to the Joint Committee on Rating Commercial Refrigerating Equipment.

In January, 1935, the Unit Air Conditioner Manufacturers Association, the name of which was later changed to the Air Conditioning Manufacturers' Association, was invited by the sponsor society to appoint three members to participate in the work of the joint committee.

In August the ASHVE was invited also to appoint three members. Consequently the Standards for Rating and Testing Air Conditioning Equipment have been compiled by a joint committee composed of members of five organizations. The Standards were finally approved by the ASRE Council September 26, 1935, and subsequently approved by ACMA in October.

Personnel

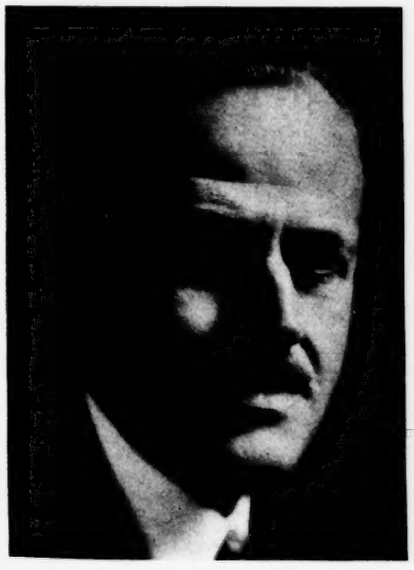
The general chairman of the Joint Committee is Glenn Muffly, Springfield, Ohio, and the secretary is Chester Lichtenberg, General Electric Co., Fort Wayne, Ind. Members of the committee and the organizations they represent are:

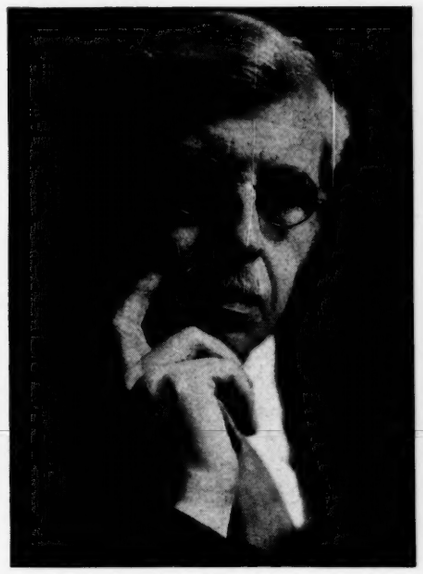
For ACMA — Chairman: D. E. French, Carrier Corp., Newark, N. J.; L. S. Morse, York Ice Machinery Corp., York, Pa., and H. M. Williams, Frigidaire Division of General Motors, Dayton, Ohio.

For ASRE — Chairman: Mr. Muffly; Frank Zumbro, Frick Co., Waynesboro, Pa., and W. R. Woolrich, Tennessee Valley Authority, Knoxville, Tenn.

For RMA — Chairman: Mr. Morse; A. H. Baer, Carbondale Machine Co., Harrison, N. J., and W. H. Carrier, Carrier Corp., Newark, N. J.

For NEMA — Chairman: Mr. Williams; Mr. Lichtenberg, and L. A. Philipp, Kelvinator Corp., Detroit.





Several of the men who were responsible for the Standards for Rating and Testing of Air Conditioning Equipment; (top center) Glenn Muffly, (lower left) Donald French, (center) L. S. Morse, (right) W. E. Stark.

For ASHVE—W. E. Stark, Bryant Heater & Mfg. Co., Cleveland, Ohio; F. H. Faust, General Electric Co., Schenectady, N. Y., and C. W. Walton, Jr., Rockefeller Center, Inc., New York.

A Summary of the Standards

The Standards describe the method of rating and testing air conditioning and air treating units of the forced convection type. The units are classified into three divisions as (1) free delivery type; (2) pressure type, and (3) interchangers.

In rating the units the Standards provide for rating at one or more air velocities through the unit, the velocity to be held constant during the test for each rating. The conditions of temperature and pressure which are standardized and maintained constantly for testing and rating purposes are given in Table 1.

Different temperature and pressure conditions are set up for testing and rating, depending on the type and operation of the unit, as will be noticed in Table 1. These are outlined in detail in the Standards.

The items required in rating cover six different classifications as follows:

(a) Name of Unit ("air conditioning unit," "heating unit," "humidifying unit," etc.) shall signify the functions of the unit and shall not imply more functions than the unit is designed to perform. For example, the name "air conditioning unit" shall not be applied to one which is not designed to embody the minimum complement of functions as defined elsewhere in the Standards.

(b) Functions which each unit performs must be designated. For example, the unit must be designated to perform one or more of the following functions: ventilation, air circulation, cooling, heating, dehumidifying, humidifying, filtering and washing.

(c) Data on air flow include air quantity, fan motor power input for free delivery units, and fan power consumption for pressure type units, as well as the air resistance of the machine.

(d) Data on cooling include the total cooling effect, sensible cooling effect, and dehumidifying effect, all in B.t.u. per hour; name of the refrigerant and the temperatures and pressures of the refrigerant at various points in the cycles, depending on the type of refrigerant.

(e) Data on heating include the heating effect, heating medium, temperature of steam entering and condensate leaving the units; pressure drop across interchanger for liquid heat and power consumption for pump, if one is used.

(f) Data on humidification include the humidifying effect in pounds of water evaporated per hour; total water consumption; source and amount of heat for humidifying when required; power consumption for spray pump if one is used; spray pressure, and temperature of water entering unit.

The Standards allow a tolerance of plus or minus 4% in the rating of the units.

A list of instruments and apparatus for tests is given in detail, the Standards specifying either the type of instrument or a choice of type of instruments by which various measurements shall be made. Inasmuch as the measurement of the air handled by the unit under test is the essential feature of the whole procedure, two methods are outlined in detail regarding the apparatus for air measurement. One method uses the receiving chamber with impact nozzle, the principle of which is specified in the ASHVE Standard Code for Testing and Rating Steam Unit Heaters. In this method the velocity of the pressure at the throat of a calibrated nozzle placed between a receiving and discharge chamber, and the temperature and moisture changes between the inlet to the air conditioning unit and the discharge from the nozzle, are measured with dry and wet bulb measuring instruments (see Fig. 1).

The second method uses the receiving chamber with static nozzle, the principle of which is substantially the same as that of the receiving chamber method with impact nozzle, except that the receiving chamber is much larger, so that the velocity pressure of the air approaching the nozzle is reduced to a negligible amount, and consequently only static pressure drop need be measured. The instruments for measuring the temperature leaving the unit are located at the discharge of a mixing box connected to the discharge of the unit rather than at the nozzle (see Fig. 2).

Details of construction for both of these setups are given in the Standards, which also specify the measurements necessary on apparatus intended specifically for cooling tests, heating tests, and humidification tests.

The information and requirements heretofore outlined take up the first four parts (A to D, inclusive). The fifth part, (E), one of the longest sections of the Standards, is devoted to testing of cooling equipment. It provides for the basis of tests, including primary and confirming test procedure in making a test, and the computation of results. The symbols for all formulas as well as the formulas are presented, as are typical log sheets for two types of cooling units. This section closes with a presentation of a summary of rating information from typical calculations as an example of the essential information resulting from the tests. This is as follows:

Definitions Set up by ACMA

A Unit *is a factory-made, encased assembly of the functional elements indicated by its name, such as air conditioning unit, room cooling unit, humidifying unit, etc.*

An Air Conditioning System *provides ventilation, air circulation, air cleaning and equipment for maintaining temperature and humidity within prescribed limits.*

An Air Conditioning Unit *is a specific air treating combination consisting of means for ventilation, air circulation, air cleaning and heat transfer with control means for maintaining temperature and humidity within prescribed limits.*

A Cooling Air Conditioning Unit *is a specific air treating combination consisting of means for ventilation, air circulation, air cleaning and heat transfer with control means for cooling and maintaining humidity within prescribed limits.*

A Heating Air Conditioning Unit *is a specific air treating combination consisting of means for ventilation, air circulation, air cleaning and heat transfer with control means for heating and maintaining humidity within prescribed limits.*

A Cooling Unit *is a specific air treating combination consisting of means for air circulation and cooling within prescribed temperature limits.*

A Heating Unit *is a specific air treating combination consisting of means for air circulation and heating within prescribed temperature limits.*

A Humidifying Unit *adds water vapor to and circulates air in a space to be humidified.*

A Dehumidifying Unit *removes water from and circulates air in a space to be dehumidified.*

A Self-Contained Air Conditioning or Cooling Unit *is one in which a condensing unit is combined in the same cabinet with the other functional elements.*

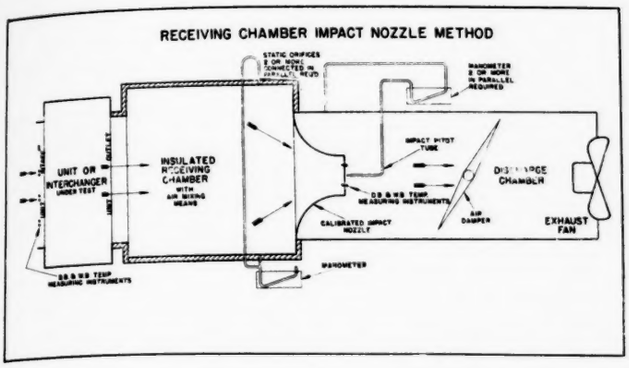
A Free Delivery Type Unit *takes in air and discharges it directly to the space to be treated without external elements which impose air resistances.*

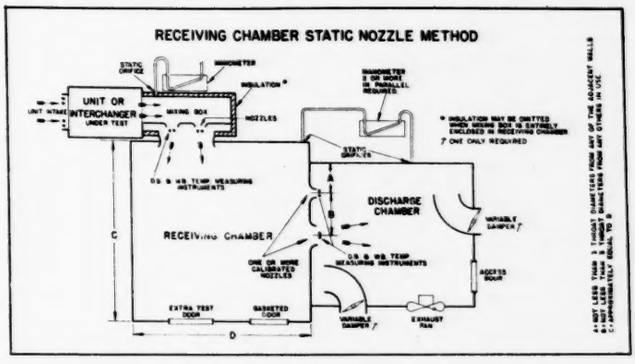
A Pressure Type Unit *is for use with one or more external elements which impose air resistance.*

An Air Heat Interchanger *effects a transfer of heat between air and a heating or cooling medium.*

Comfort Air Conditioning *provides ventilation, air circulation, air cleaning and maintains temperature and humidity for the comfort of people.*

Commercial Air Conditioning *provides ventilation, air circulation, air cleaning and maintains temperature and humidity for the benefit of products or industrial processes.*





(Left) Apparatus for measuring air—the receiving chamber with impact nozzle method. (Right) An alternate method for testing air measurements—the receiving chamber with static nozzle method.

RATING INFORMATION FROM TYPICAL CALCULATIONS

COMFORT COOLING RATING FOR VOLATILE REFRIGERANT AIR COOLING AND FILTERING UNIT

Name ..... *Model X cooling unit*
Type ..... *Pressure*
Functional elements ..... *Cooling coil, air filters*
Refrigerant ..... *Freon (dichlorodifluoromethane)*
Temperature of refrigerant vapor leaving cooling unit ... *48°*
Air capacity (Std.) ..... *2000 c.f.m.*
Sensible cooling effect ..... *43,100 B.t.u. per hr.*
Dehumidifying effect ..... *26,300 B.t.u. per hr.*
Total cooling effect ..... *69,400 B.t.u. per hr.*
Fan motor input ..... *1,190 watts.*
Air resistance of unit ..... *0.40 in. of water*

The sixth part of the Standards covers similar information for the testing of heating equipment, both steam and hot water. It gives the symbols, formulas, methods of computation, and test results for this type of equipment.

The seventh part is similar, but covers the testing of humidifying equipment.

TABLE 1. CONDITIONS FOR TESTING AND RATING.

FUNCTION	MEDIUM	RATING RANGE	AIR ENTERING		FLUID TEMPERATURE, °		
			TEMP.°	REL. HUM., %	IN	OUT	SAT. REFR. VAPOR
Cooling	Volatile refrigerant	Comfort	80	50	90		40
		Commercial	45	85	90		30
	Non-volatile refrigerant	Comfort	80	50	40		..
		Commercial	45	85	30		..
Heating	Steam		70	..	218.5		..
	Liquid		70	..	180	160	..
	Other		70	..	..		..
Humidifying			70	30	..		..

The eighth section of the Standards is devoted to definitions of different types of units as well as some additional definitions relating to heating, cooling, and humidifying effects. A number of these definitions are presented elsewhere in this article.

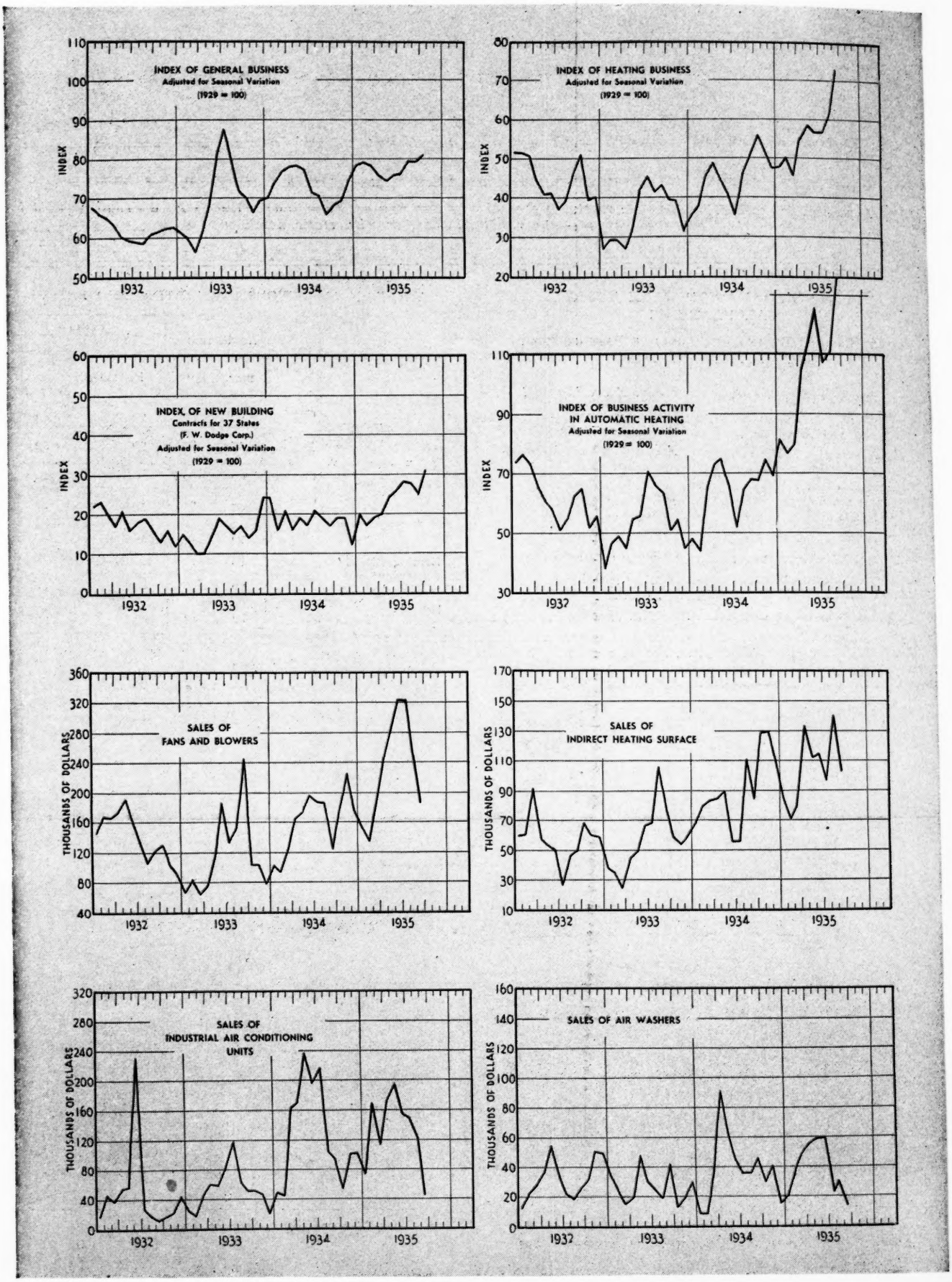
Germs Carried on Dust Particles

GERMS use invisible dust particles as airplanes in traveling about a room, is the conclusion of the American Institute of Sanitation based upon a series of tests to determine the relation of dust to the spread of disease germs.

Particles of dust were counted by exposing a moist glass to the air and then examining it under the microscope. Bacteria were counted by exposing a glass dish covered with a film of agar-agar to the air for two minutes. Colonies of bacteria were developed by the standard method of incubation for 24 hr. at a temperature of 98°, at the end of which time each germ had developed into a colony large enough to be seen with the naked eye.

"Increasing the amount of dust particles in a room by sweeping with a broom or swishing the furniture with a feather duster, brought about corresponding increase in the number of bacteria colonies which developed about the bits of dust on the test dishes. This indicates," says the institute, "that although germs are unable to fly of themselves, they do attach themselves to microscopic dust particles and thus are able to travel immense distances in relation to their size. A germ that hitch-hikes ten feet is equivalent to a man flying across the Atlantic."

BUSINESS TRENDS



Automatic Heating 36% Above 1929 Levels; All Indexes Up

THE heating business, as reflected in HEATING & VENTILATING'S Index of Heating Business Activity, showed an advance of over ten points in September as compared with August, after corrections had been made for seasonal trends. The Index now stands at 72.7, as compared with 61.1 in August, and as compared with 50.4 in September of 1934, the figures being in per cent of 1929 averages. The great increase in the sale of residential stokers compared with increasing business in oil burners brought the Index of Automatic Heating to the highest level since it was begun. It now stands at 136.1% of 1929 levels, based on physical volume of business. According to the Index of Heating Contractor Business Activity adjusted for seasonal trends, contractors are now busier than at any time since November, 1931.

According to reports on summer air conditioning from 13 electric utilities October business was sharply off from October a year ago, largely due to less activity

(Concluded on page 71)

HEATING BUSINESS TRENDS AND EQUIPMENT SALES

INDEXES (1929 = 100), SEASONALLY ADJUSTED	SEPTEMBER, 1935	SEPTEMBER, 1934	9 MO. AVERAGE, 1935	9 MO. AVERAGE, 1934
HEATING & VENTILATING'S Index of Heating Business	72.7	50.4	54.8	42.6
HEATING & VENTILATING'S Index of Automatic Heating	136.1	68.0	103.9	62.0
HEATING & VENTILATING'S Index of Heating Contractor Activity	54.8	46.5	42.8	36.5
	OCTOBER, 1935	OCTOBER, 1934	10 MO. AVERAGE, 1935	10 MO. AVERAGE, 1934
Index of New Building Contracts	31	17	24	19
HEATING & VENTILATING'S Index of Stock Prices, 11 Manufacturers, unadjusted, unweighted	52.7	26.6	39.4	26.3
EQUIPMENT	**SEPTEMBER, 1935**	**SEPTEMBER, 1934**	**9 MO., 1935**	**9 MO., 1934**
Oil burners, number of units shipped in U. S., mechanical draft type	23,175	12,949	75,365	48,511
Boiler-burner units, number shipped in U. S.	1,559	1,459	6,733	5,686
Ventilating blowers, orders in dollars	67,322	44,763	709,470	542,594
Small housed blowers and propeller fans, orders in dollars	119,310	94,629	1,415,560	962,531
Air washers, orders in dollars	14,870	46,767	351,112	431,944
Industrial air conditioning units, orders in dollars	44,993	94,322	1,197,868	1,391,127
Industrial unit heaters, orders in dollars	510,983	345,509	2,307,280	1,898,904
Schoolroom unit ventilators, orders in dollars	99,415	104,834	1,122,703	942,291
Non-ferrous indirect heating surface, orders in dollars	98,267	66,975	845,782	621,281
Cast iron indirect heating surface, orders in dollars	4,099	15,412	73,862	71,653
Residential stokers, sales in number of units	8,687	3,262	24,961	9,669
Steel boilers, orders in square feet of heating surface	216,720	208,436	1,383,783	823,221
Cast iron round boilers, shipments in thousands of pounds	6,879	6,258	29,474	29,716
Cast iron square boilers, shipments in thousands of pounds	31,761	25,208	124,296	106,169
Cast iron radiators, shipments in thousands of square feet	7,701	6,262	35,436	30,216
Non-ferrous convectors, sales in square feet, elements only	58,713	44,456	537,123	557,920
Non-ferrous convectors, sales in square feet, with cabinets	186,531	157,709	1,250,498	1,048,462
Cast iron convectors, sales in square feet	441,948	143,449	2,050,345	985,386

SUMMER AIR CONDITIONING INSTALLATIONS REPORTED BY 13 UTILITIES FOR OCTOBER, 1935†

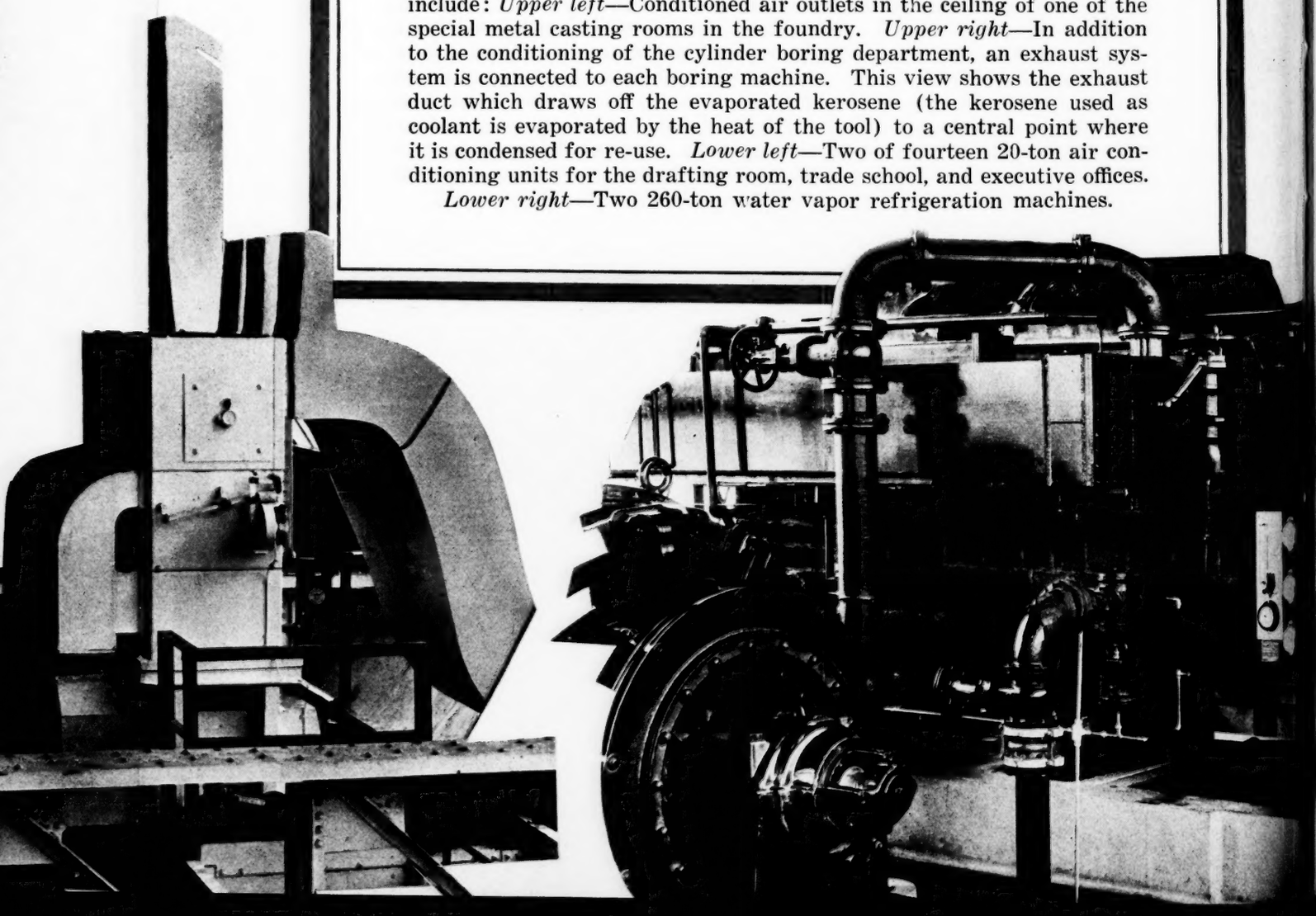
CITY	OCTOBER, 1935		OCTOBER, 1934		TEN MONTHS, 1935		TEN MONTHS, 1934	
	NO.	HP.	NO	HP.	NO.	HP.	NO.	HP.
Boston	4	87	2	23	55	1588½	44	2734
Chicago	7	170	3	218½	305	5410	233	5628½
Hartford	0	0	—	—	14	172	—	—
Indianapolis	4	75	14	920	24	1450	12	800
Newark[1]	2	28	2	3	91	1059	92	5123/4
New York:								
Manhattan and Bronx	4	62½	—	—	197	7289	—	—
Queens	0	0	0	0	9	161¼	23	268
Philadelphia	3	55¼	2	72¼	136	4695	151	2345
Rochester	0	0	—	—	26	602¼*	—	—
Scranton	0	0	—	—	10	138	—	—
Syracuse	—	—	—	—	6	211	3	28
Toledo	0	0	0	0	23	426	1	10
Washington	4	4	4	5400[2]	155	7036½	79	14,842¼[3]
TOTAL, 13 Reports	28	481¾	—	—	1051	30,238½	—	—
TOTAL, Those Reporting Both Years	24	419¾	27	66363¼	804	22,037½	638	27,168½

†Dash indicates no report, not that no jobs were installed.
[1]Includes Jersey City.
*Revised figure.
[2]Includes 2 large government installations.

Air Conditioning at the Ford Plant

Over 2,000 tons of cooling capacity for comfort conditioning is installed in the foundries, cylinder boring department, offices, and other parts of the Ford Rouge plant in Dearborn. These views have been selected from a number of photographs of the systems at the Ford plant, and include: *Upper left*—Conditioned air outlets in the ceiling of one of the special metal casting rooms in the foundry. *Upper right*—In addition to the conditioning of the cylinder boring department, an exhaust system is connected to each boring machine. This view shows the exhaust duct which draws off the evaporated kerosene (the kerosene used as coolant is evaporated by the heat of the tool) to a central point where it is condensed for re-use. *Lower left*—Two of fourteen 20-ton air conditioning units for the drafting room, trade school, and executive offices.

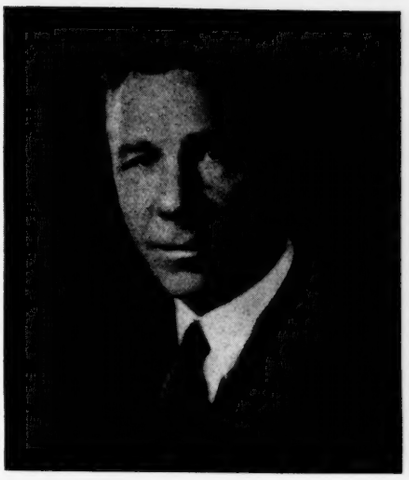
Lower right—Two 260-ton water vapor refrigeration machines.



Chicago Air Conditioning Standards Finally Adopted

RESULTING from activities begun in 1933, tentative standards for Certified Air Conditioning for Comfort were adopted February 6, 1935 by the Chicago Master Steam Fitters Association in cooperation with the Western Society of Engineers and the Ventilating and Air Conditioning Contractors Association of Chicago. These standards have been described in a previous issue.†

The committee was later expanded to include other interested organizations, for differences of opinions as to the advisability of such standards had been voiced by various individuals and trade groups. As a result of discussion a permanent organization was effected, known as the Chicago Air Conditioning Standards Advisory Council, of which John Howatt is chairman. Mr. Howatt's committee, known as the Chicago Committee on Air Conditioning Standards, met on June 14.



John Howatt, chairman of the Chicago Air Conditioning Standards Advisory Council, which formulated the air conditioning standards for Chicago.

When this committee was organized under Mr. Howatt's chairmanship, it set out, to use his words, "with three objectives: one, to prepare Standards; two, to publicize them; and three, to make them effective. We have arrived at our first objective. The second and third will be developed together, we believe, through the proper publicity given to these Standards. We believe when the prospective customer knows of the existence of Standards he may direct that the equipment or installation he is purchasing shall be designed or shall render performance in accordance with those Standards. This will serve to minimize the chiseling that has been carried on, will serve to protect the customer and will serve to raise the quality level of the new air conditioning installations."

In addition, Mr. Howatt has emphasized that these Standards are set up for Chicago only. The committee hopes that they will prove an impetus to the development of similar standards in other large communities.

The final Standards were adopted October 17, 1935. They are sponsored by the Illinois Chapter, ASHVE; the Chicago Section, ASRE; Refrigerating Machinery Association; Western Society of Engineers; Chicago Association of Consulting Engineers; Chicago Master Steam Fitters Association; Ventilating and Air Conditioning Contractors Association of Chicago; National Electrical Manufacturers Association, and the Illinois Society of Architects.

The Standards in full follow:

†See "Engineering Provided for in Chicago Standards for Certified Air Conditioning," HEATING & VENTILATING, May, 1935, page 34.

The Chicago Standards

1. Scope — These standards are intended to set forth minimum requirements only.[1]

2. Definition of Air Conditioning— For the purpose of these standards, Air Conditioning is defined as the process by which the temperature, moisture content, movement and cleanliness of the air in enclosed occupied spaces intended for human occupancy are maintained within definite required limits. For purposes of public protection these standards recognize apparatus which performs: (a) all of the above functions in winter; (b) all of the above functions in summer, and (c) all of the above functions in all seasons.

If an installation does not perform all of these functions it shall be called by a name which describes only the function performed. For instance, neither a temperature controlling nor an air moving apparatus may be called an air conditioning apparatus.

3. Design Coefficients for Heat Transfer Through Construction Barriers and for Heat Gains from People or Appliances—shall conform to the standards recommended by the current issue of The Guide, American Society of Heating and Ventilating Engineers.

4. Minimum Standards for Refrigeration Apparatus—shall conform with the current issue of the Refrigeration Data Book, American Society of Refrigerating Engineers.

5. Minimum Design Temperatures and Humidities for Heating—shall be —10° outside and 70° inside. The humidifying apparatus shall be designed to furnish at least 35% relative humidity when the outside temperature is 30°.[2]

6. Minimum Design Temperatures and Humidities for Cooling—shall be such as to cover both of the following conditions: (a) outside 95° D.B. and 75° W.B.; inside 80° and 50% R.H. or equal effective temperature as determined from the summer comfort chart in ASHVE Guide; (b) outside 80° D.B. and 75° W.B.; inside 78° and 52% R.H. or equal effective temperature as determined from the summer comfort chart in ASHVE Guide.

7. Infiltration and Leakage—Design capacity to care for infiltration of air from outside shall be provided in all heating systems in accordance with the latest issue of the ASHVE Guide.[3]

8. Design Load Calculations—(a) For winter air conditioning shall include allowances for heat loss through: (1) physical barriers such as walls, doors, windows, ceilings, floors, etc.; (2) infiltration, and (3) outside air for ventilation by mechanical means.

(b) For summer air conditioning shall include pertinent allowances for heat gain from the occupied zone through: (1) physical barriers such as walls, doors, windows, ceilings, floors, etc.; (2) outside air for ventilation by mechanical means; (3) sun heat; (4) heat and moisture from

[1]By no means are they to be understood as limiting good practice or as preventing progress or invention.

[2]In buildings of ordinary construction a R.H. of 35% will cause sweating at outside temperature below 30°.

[3]Nothing in these standards shall be taken as preventing an allowance for infiltration and leakage when cooling.

occupants, and (5) heat and moisture from appliances, illumination, combustion, etc.

The basis of all of these allowances shall conform with the coefficients in the current issue of the ASHVE Guide, except where these standards give other specific requirements.

9. Design Allowance for Shading from Sunshine—shall be made only when the plans and specifications specifically show such allowance, and when they give assurance that the owner is cognizant of the reduction in capacity on this account.

10. Design Air Quantity—If the heat is to be transported into the room or out of the room by the air, either when heating or when cooling, the quantity and temperature and moisture condition of the air must be such as assuredly to accomplish the work. In addition: (a) the basis of design for heating equipment, air volumes, ductwork and outside air connections shall be not less than the requirements of the Chicago Municipal Code; (b) summer air conditioning not covered by the Chicago Municipal Code when refrigeration or other cooling equipment is used, shall provide for the positive introduction of at least 10 c.f.m. of outside air per stated occupant, and for restaurants, beauty parlors, rooms with heavy smoking, and other rooms with special sources of contamination, this shall be increased to a minimum of 15 c.f.m. per stated occupant. Where the occupancy is not known, or where the stated occupancy is below the Chicago City Code stipulation, the latter shall govern in determining occupancy.

11. Design Duct Capacity—Provision may be made in the duct design for recirculation of 100% of the circulated air.[4] The inlets, outlets and ducts shall have sufficient capacity to permit the introduction of 100% of air from outside and its removal.[4]

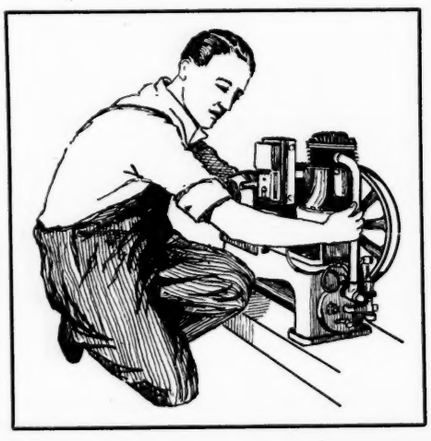
12. Design Air Distribution—shall be such that: (a) there shall be no mechanically produced air velocity within the occupied zone exceeding 50 lin. ft. per min.; (b) the difference between the temperature of air currents in the occupied zone and the average temperature of the occupied zone shall not be greater than as shown below for the various air current velocities:

Air Current Velocity Lin. Ft. per Min.	Temperature Difference Average ° Minus Current °
40 and over	2
Less than 40	3

(c) The temperature shall not vary more than 2° at the same level within the occupied zone.[5]

13. Refrigerating Apparatus and Refrigerants—All refrigerating and cooling equipment, piping and specialties used in connection with air conditioning shall be designed and installed in accordance with the requirements of the City of Chicago, Department of Boiler Inspection and Cooling Plants, and the rules of the Chicago Board of Health.

The following are minimum acceptable capacities for various parts of the refrigerating apparatus to be used in cooling: (a) assumed condenser cooling water temperatures 76° for city water and 80° for cooling tower water; (b) when the refrigerant is flammable, irritant or toxic, a receiver of sufficient capacity to contain the entire operating charge of refrigerant shall be provided. Under such conditions adequate valves and facilities shall be provided for storing all of the refrigerant within the receiver;[6] (c) apparatus such as evaporators, condensing units, expansion valves, etc., shall be installed with sufficient line valves and with proper fittings to permit efficient servicing or quick replacement of operating parts without exposing the interior of the refrigerant-containing parts to air and moisture where such exposure would affect the system adversely; (d) accessibility for servicing and repairing of all parts of the air conditioning system must be provided, and (e) a leak-detecting device approved by the Chicago Board of Health must be provided where required.



14. (a) The parts exposed to moisture shall be made of material at least equal to galvanized steel, and the gauges and weights of sheets and structural bracing shall conform with the recommendations of the ASHVE Guide; (b) each branch of a duct system shall be provided with means for adjusting the air volume delivered.

15. Heat Transfer Apparatus—(a) All convectors where condensation might occur when cooling shall have drain pans with tubing running to a drip with air break above a trapped sewer connection or its equivalent; (b) no fixed spray humidifier or spray dehumidifier shall be installed above the basement of a building unless there shall have been installed under it a water-tight safing graded to a drain so that in case of leakage or overflow there shall be no danger of water damage to the rooms under the apparatus; (c) eliminator plates shall be provided for spray humidifiers, for spray dehumidifiers and shall be made of some durable material and so designed as to be easily replaceable; (d) air filters shall be easily accessible for inspection and removing without danger of spilling dust to the leeward of themselves when the substitution is made.

16. Noise Control—The following increase in noise level measured in the occupied zone nearest to the source of the noise and due to operation of air conditioning apparatus shall not be exceeded:

Existing Noise Levels Air conditioning Not in Operation Windows and Doors Closed Occupation and Activity Normal Decibels	Resultant Maximum Sound Levels Air Conditioning in Operation Decibels
5	7
10	15
15	23
20	30
25	38
30	45
35	52
40	60

17. Insulation—In air conditioning work in which refrigeration is employed, all chilled surfaces exposed to temperatures and humidities which cause deposition of dew shall be insulated to such an extent at least that no condensation shall gather outside of the insulation.

18. Guarantees—Guarantees of performance when required shall be limited to capacities or conditions that are described and can be measured accurately and the guarantees shall state the condition under which such capacities or results are to obtain.

[4]This is for economical heating or cooling prior to occupancy.

[5]Nothing herein shall be taken to prevent use of deflectors, diffusing grilles, nozzles and the like with comparatively high velocity air currents above the occupied zone.

[6]Should the apparatus be required for both cooling and heating at intervals during the same season, the evaporator shall be so arranged that it is not exposed to temperatures which will cause a pressure greater than that for which the evaporator was designed.

Industrial Type Building Heated by Waste Heat

By W. J. PURCELL† and D. M. DART‡

THE building which houses the General Electric Company broadcasting stations WGY, W2XAF, W2XAD, and state police transmitter WPGC had a heating system which had been in operation for many years, and the boiler was in need of extensive repairs. The system consisted of unit heaters located in the rooms, supplied with steam from a boiler fired with a conversion oil burner.

The primary heating system installed January 15, 1935, makes use of waste heat from the transmitter tubes. These tubes are 33% efficient and are cooled by water. This water circulates to carry away 67% of the energy in the form of heat. The water is then passed through a radiator, cooled, and returned to the tubes to be used again. A blower forces air over this cooling radiator, in previous practice cool air being drawn from outdoors, and the heated air discharged outdoors. This heated air was, then, actually waste heat which, with the new system is used to assist in heating the building. A duct system was installed to convey this heated air to all portions of the building, in proportion to the heating required in each space. A total of 150 kw., or 500,000 B.t.u. per hr., is thus available for useful heating, at no additional operating expense.

There are two limitations to this method which necessitate the use of an auxiliary heating system. The first is that the heat supplied by the tubes is sufficient to meet the heating requirements only when the temperature outdoors is above 25°. In the second place, while these stations operate on different schedules, basically they operate from 6 a.m. to 1 a.m. daily, or only 19 hr. During the five hours at night when the stations are usually shut down, it must be possible to maintain the entire building at 70° to facilitate work which may be in progress.

Considering these demands, some form of automatic and reliable auxiliary heating system was needed to meet the specific requirements. Oil burner-boiler units were installed to meet all these conditions, supplementing the distribution of waste heat from the power tubes.

This combined system provides automatic operation and accurate control of temperature throughout the building. The temperature in the rooms is maintained by varying the amount and temperature of the air supplied. This is accomplished through a set of dampers at the blower intake and a similar set at the outlet. Adjustment of these dampers makes it possible to draw air from the building or from the outdoors as requirements dictate. Likewise it is possible to discharge all the heated air through the duct system to the building or directly outdoors. Between these extremes it is possible to vary the air flow and air temperature to the building, making possible an accurate control of temperature. This method of control is in operation at all times, until the heating load requires all of this heated air to be distributed through the duct system. When this maximum condition is reached, if the temperature in the room falls below a predetermined value, the thermal controls which regulate the boiler-burner units automatically start them. Additional heat is then supplied through the unit heaters to maintain the desired temperature.

From the previous description it is apparent that the boilers supply sufficient additional heat in severe weather, and also full heating when the transmitters are not in operation.

Comfort is of utmost importance, and implies considerably more than merely providing proper air temperature. Adequate air movement is important to equalize temperatures throughout, and also minimize floor-to-ceiling temperature differences. This combined result is obtained by the duct system which utilizes the waste heat. Heated air being distributed throughout the building and returned through several openings, provides a gentle but very definite air movement. In addition, in all but the most severe weather, varying amounts of outside air are admitted, giving an adequate change of air in the building.

Building characteristics are important in emphasizing the factor of reliability. The building is roughly 160 ft. long, 50 ft. wide, and one story high. The structure is of steel and brick, the greater portion of each wall area consists of windows. The floor of the building is concrete, and is directly in contact with the ground. The roof is supported by structural steel and is made of 2-in. planks covered with a waterproofing.

The WGY transmitter is in a room 60 ft. x 25 ft., the two short-wave transmitters in a room 40 ft. x 25 ft., and the police transmitter, machinery room, and workshop are in a room 100 ft. x 50 ft. Each of these spaces may have different periods of heating which makes individual control desirable.

The building characteristics enumerated above serve to illustrate the shell construction of the building. Considering the large glass area, the rate of heat loss is very high. In sub-zero weather, with all equipment shutdown, a failure in the heating system would result in a temperature reduction in the building of approximately 30° the first hour. At this rate the temperature would reach freezing in a relatively short time. Then, to avoid extensive damage to the expensive water-cooled tubes and circulating equipment, each device would have to be drained rapidly.

Consequently, minimizing the possibility of freezing

†Engineer, Station WGY, National Broadcasting Company.
‡Air Conditioning Department, General Electric Company.

due to failure for any reason was of major importance. This could be accomplished best in two ways; either the installation of standby equipment, or the installation of several smaller units in parallel, in which case the possible failure of any one would not be serious. The use of five small boiler-burner units provides this degree of safety without excess equipment for standby. Also this arrangement makes possible the division of these units to supply steam for smaller zones —each under separate thermostatic control. The installation in the large machinery room uses three oil burner-boiler units connected in parallel and thermostatically controlled. Reliability was thus obtained, and also one, two, or three boilers can be operated at maximum efficiency depending upon severity of the weather.

In the same way, two boilers in parallel were installed to supply the short-wave room and WGY room.

The old system required 20,000 gal. of No. 3 fuel oil for an average heating season. With the new system, 8,100 gal. of No. 4 fuel oil will be required for an average heating season.

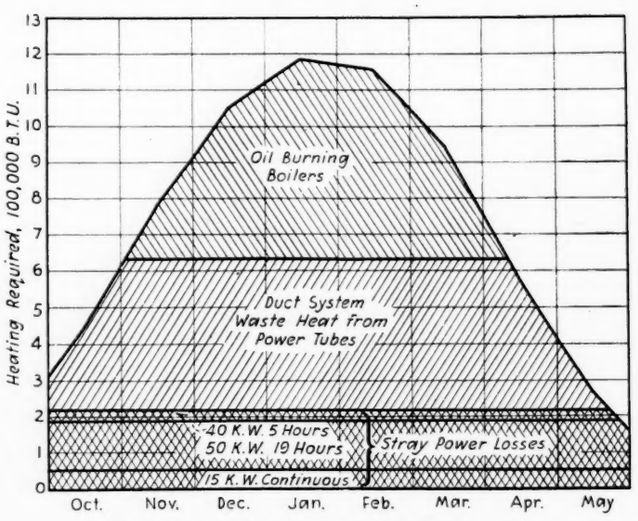


Fig. 1. Operating time of combined systems.

The new system was placed in operation January 15, 1935, and on April 4, 1935, 3,620 gal. of No. 4 oil had been used. Based on weather bureau data for this period, 3,407 degree-days of heating had been required (at Schenectady, N.Y.). For a normal year, the total degree-days are 7,650. The consumption of fuel per season calculated by direct proportion, indicates a fuel saving of 61%.

Fig. 1 shows graphically the heating required by this building, and the various ways in which it is supplied. The areas under the curve represent the actual average amounts of heat supplied from each source. However, the oil fired boilers must be capable of supplying the entire amount during periods when the station is not in operation. On this curve, the area showing stray power losses represents the heat dissipated to the rooms from operating equipment. Power tubes, transformers, etc., give off heat by radiation and convection which aids in heating these spaces. In each case, these losses are much greater in magnitude than shown, but only for a definite period of time. The values given represent the average heating from each source.

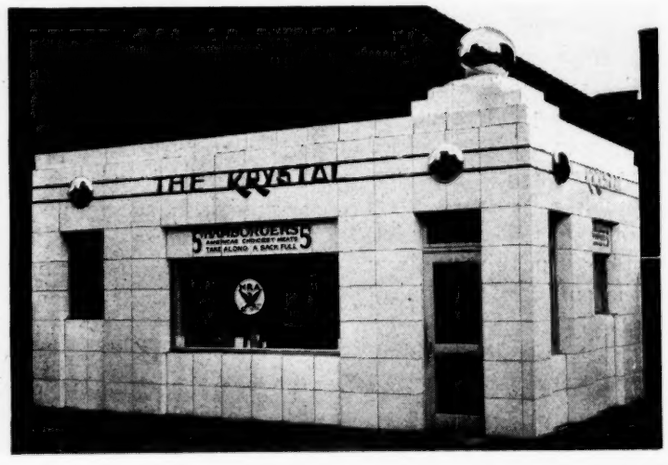
Air Conditioning for Hamburger Stand

FOLLOWING a midsummer installation of air conditioning equipment, The Krystal Company of Chattanooga and Atlanta, operator of a chain of hamburger and refreshment stands, report complete satisfaction in what is probably the smallest interior space ever air conditioned, 18 ft. x 13 ft.

While only one of the eight units operated by the company was air conditioned as an experiment, it is stated by J. Glenn Sherill, manager of the concern, that other installations will be in readiness before warm weather returns again.

These miniature restaurants, beautiful in appearance, are constructed of white porcelain with chromium - plated trimmings. The exterior dimensions are 25 ft. x 18 ft.

Equipment used in the Krystal installation sold by The Tennessee Electric Power Company's commercial department, consists of two suspended type air conditioners, which were hung on the wall behind a counter and about two feet below the ceiling, and one air conditioning condensing unit which was placed in a specially built little house outside the building because there was not room for it inside. The cost of equipment and installation was $1,100.



Indicating that the public is becoming more conscious of air conditioning and that sales agencies are increasing their business in this line, air conditioning equipment sold by The Tennessee Electric Power Co. from January 1, 1935, through August 25, 1935, represented a total horsepower of 415.29, as compared with a total horsepower of 144 for the entire year of 1934.

Department of Interior Building, Washington, D. C.

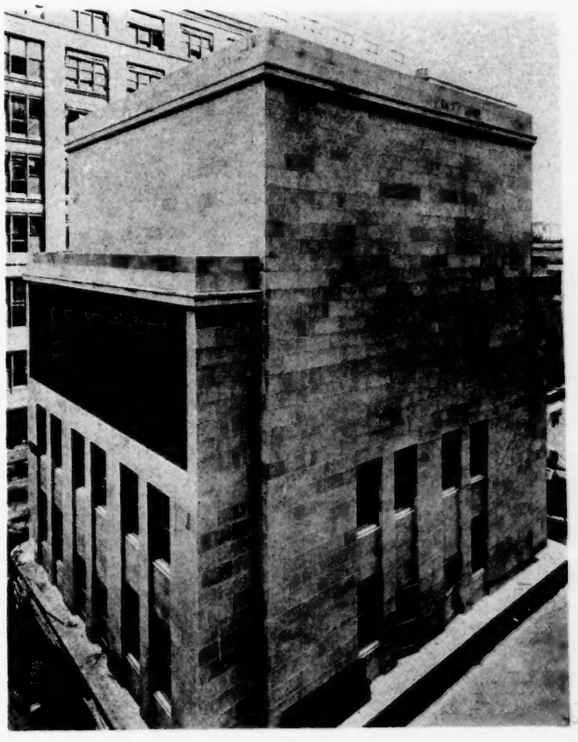
A Million Dollar Modernizing Job

The Department of Interior Building in Washington, recently air conditioned by the Government, contains over 8 million cubic feet of conditioned space. The installation was in operation within 150 days after the order was placed

By M. S. LEBAIR†

PREEMINENT as a major achievement of the year in the air conditioning industry is the installation in the vast U. S. Department of Interior Building in Washington. This contract was unique in many respects, and required trained engineering ability and field experience, in addition to equipment suitable for government acceptance. The order was the largest single contract ever placed for an air conditioning installation, and involved an expenditure of about $1 million.

One of the outstanding features of the job was the speed with which it was executed. The contract specified certain dates on which certain portions of the building were to be cooled last summer, and the whole installation was to be in operation within 150 days after the order was placed.

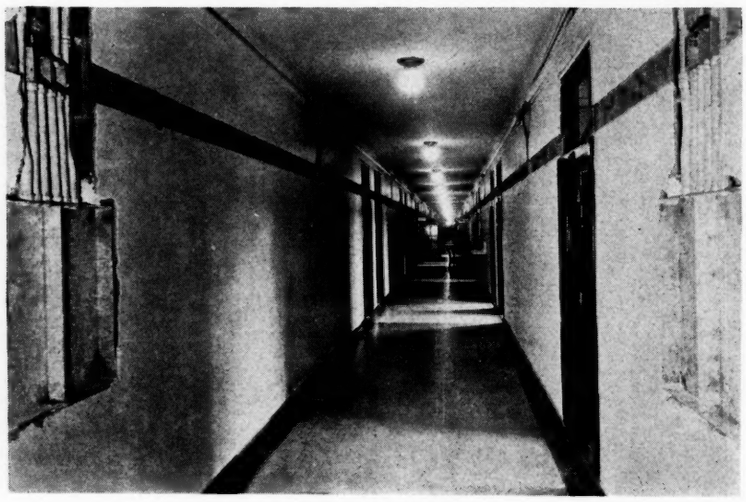


This huge five-story cooling tower is located in a court of the Department of Interior Building and is surrounded on all sides by the main building.

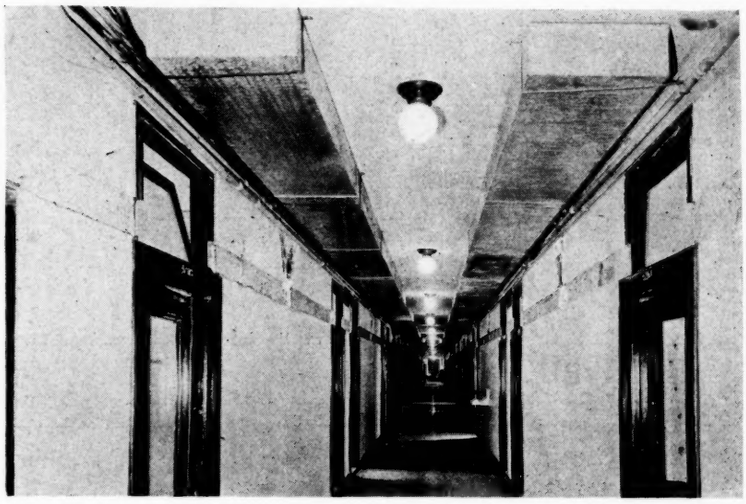
One of the largest Government buildings in Washington, the Department of Interior Building is located at Eighteenth and F Streets, NW., on a plot approximately 400 ft. square. Although it is an up-to-date office building, air conditioning was not installed when it was built. It is divided into three wings, each about 50 ft. wide, with a head house on the north side. The courts between the wings are 125 ft. wide. One of these, as will be mentioned later, was used as space for the cooling tower building.

Originally the building consisted of six floors, a ground floor, and a basement. Later an additional story was added. The conditioning for this floor was included in an ear-

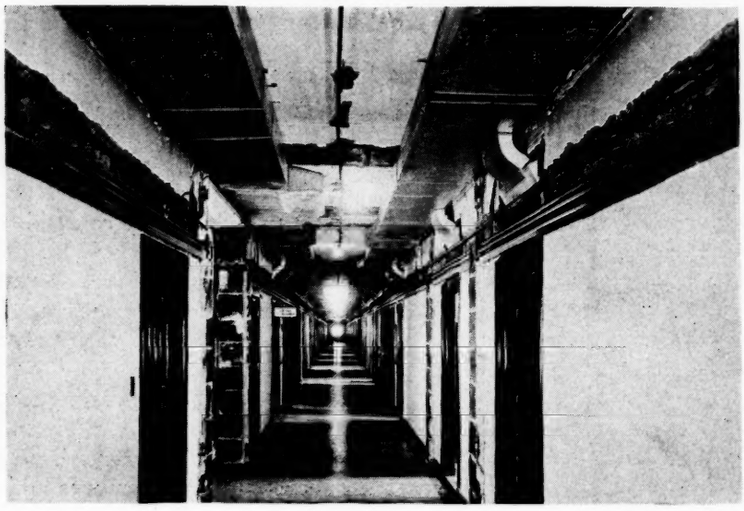
†Sales manager, Philadelphia branch, York Ice Machinery Corporation.



1 *Pictures on these two pages show six steps in preparing the halls for the air distribution. This illustration shows the conduit boxes for lighting and power to the air conditioning installed, with walls recessed for the air tubing for the automatic controls.*



2 *The air supply ducts are now in place and there are two trunk lines each supplying the offices on its side of the hall.*



3 *The branches supplying air to each room over the doors have been installed, the lights removed, and the lighting conduit lowered.*

lier contract. With the exception of corridors, the auditorium and the library, the building contains 1483 rooms. The total volume of the conditioned space in the building, including parts of the basement, is 8,164,300 cu. ft. This is equivalent to a volume 40 ft. square and nearly a mile long.

Under the main contract, equipment was supplied and installed to provide air conditioning during all seasons in all parts of the building with the exception of the new seventh floor, the east wing of the sixth floor, and the map reproduction department of the Geological Survey.

The air conditioning equipment for the building consists of three complete water cooling systems (each of which would be capable of conditioning a fair sized building), 68 surface conditioners, and two dehumidifiers. The apparatus for the seventh floor will be mentioned later. This major portion of the building is divided into 70 zones, 68 having separate conditioners and the other two, consisting of the library and the auditorium, being handled by the dehumidifiers.

Each water cooling system is of the York standard design having a compressor, condenser, water cooler, liquid pump, and chilled water pump.

Compressors

The compressors are enclosed vertical, single acting, four cylinder machines, having a bore of 15 in. and a stroke of 13½ in. Each machine is equipped with bypasses for capacity reduction. This permits a reduction in capacity to be made as the load demands without changing the speed of the machine or decreasing the supply of condenser water. Synchronous motors of the engine type, rated at 350 hp., drive the compressors at 257 r.p.m. These motors are designed to operate at unity power factor thus improving the overall power factor for the building. Separate 7½-kw. motor generator sets, driven by 15-h.p., a. c. motors, supply the excitation for the main motors. Complete automatic starting panels are provided.

The condensers are of the shell-and-tube type 53 in. in diameter and 16 ft. in length. Each contains 352 tubes 2 in. in diameter, providing sufficient active surface for good heat transfer. The water coolers are similar in construction but slightly smaller. These have a diameter of 43 in. and a length of 16 ft.

A high pressure float control valve on each system provides control for the refrigerating

liquid. A refrigerant pump, driven by a 5-hp. motor, circulates the low pressure liquid from a low pressure receiver into the water cooler, obtaining maximum efficiency by a recirculating system. Approximately 10,000 lb. of refrigerant were required to charge the three systems.

Pumps and Dehumidifiers

The three 2,000-g.p.m. chilled water pumps, driven by 125-hp. induction motors, and the two 400-g.p.m. chilled water pumps on the original seventh floor installation were all connected to a common header so that any combination of pumps might be used as required. One of the larger pumps is to be used as a standby.

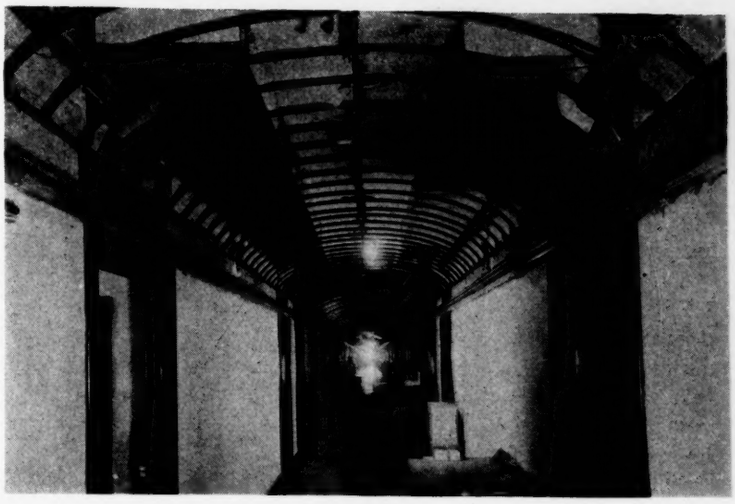
The 68 conditioner units are made up with copper tube corrugated copper fin coil sections, varying in depth from 8 to 12 in. Each unit is complete with separate cooling and heating coils, filters, humidifying nozzles, bypass dampers with control mechanism, fans with V-belt drives, and fan motor. Double section preheaters for the outside air are also provided. The amount of air circulated by each unit is determined by its size, ranging mostly from 4,000 to 8,000 c.f.m.

The dehumidifiers for the zones including the auditorium and the library are constructed of No. 18 gauge steel. They were supplied complete with spray nozzles, pipe coils, supply water float, water heater and eliminator plates. The larger unit contained four spray banks and 1,150 ft. of ¾-in. pipe coil arranged in two banks. The smaller unit, which was shorter in length, had only three spray banks and 770 ft. of ¾-in. pipe coil arranged in two banks.

Pumps driven by 7½-hp. motors supplied the necessary 200 g.p.m. of water through the spray nozzles. The air velocity through the free area of the casings was limited to 600 f.p.m. It was necessary that the dehumidifiers be designed so that the temperature difference between the air and water leaving the units should not exceed 2°, and the rise in dewpoint due to entrainment of moisture in the leaving air should not exceed 1°.

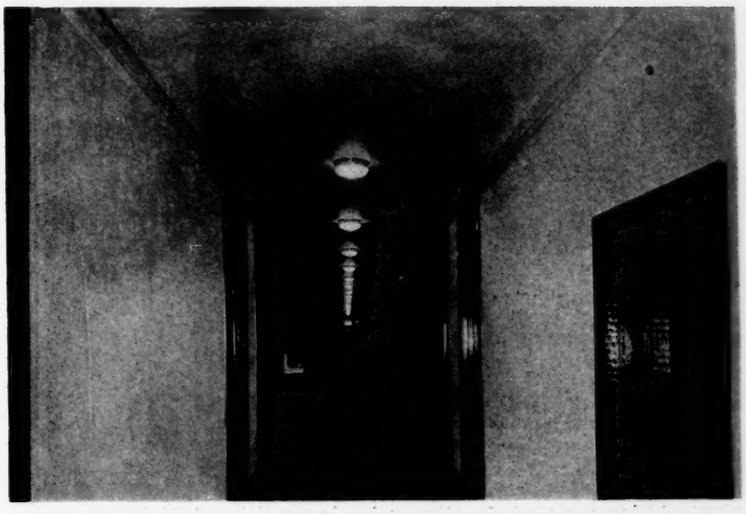
Zoning

The building is divided so that the zones in the bays are divided in east and west zones. In the other parts of the building, the zones are north and south zones. One room in each wing on each floor was designated as an equipment room to house the conditioner units. As a rule, two conditioners were placed



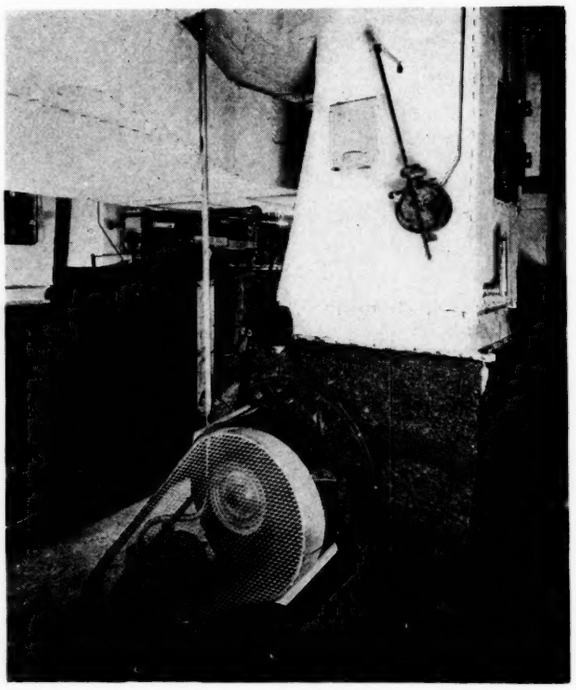
4 *The metal laths prepare the halls for the false ceiling which will conceal the ductwork and conduits.*

5 *The lighting fixtures are in place, the rough coat of plaster applied on the false ceiling in foreground, and the second coat of plaster applied on the ceiling in the background.*



6 *The finished hallway. Note the improvements in appearance between the view shown above and Fig. 1.*

in each room, one supplying air to all rooms on one side of the corridor and the other unit supplying air to all rooms on the other side. Each zone is actually a complete system with its individual conditioner and set of controls. The supply ducts from the two conditioners in each room extend in the corridors and along the corridor ceilings, connections being made to each room through the transom above the door. The return air is taken from the offices to the corridor through openings made by undercutting the doors about one inch. This air is removed from the corridor and returned to the conditioners.



Cork insulation being applied to two surface type air conditioners in one of the rooms devoted to this equipment.

The air distribution system for the auditorium differs somewhat from that of the other zones. Several large grilles discharge the air into the dome, supplementing two plaques near the stage and one on the stage. The one on the stage is so constructed that no air will be thrown against the picture screen. The return air is removed from the auditorium through mushroom type outlets under the seats and carried to the dehumidifier.

The supply ducts for the library are not concealed, but are insulated with corkboard.

Unusual in another respect, the conditioning installation also provides air for the kitchen. Due to the heavy heat concentration few kitchens are provided with this refinement. No return air is taken from the kitchen and cafeteria.

Outside air connections were made to each unit in the zone apparatus rooms from the outside wall in these rooms. Copper louvers were supplied in each of these windows, providing the necessary protection against rain.

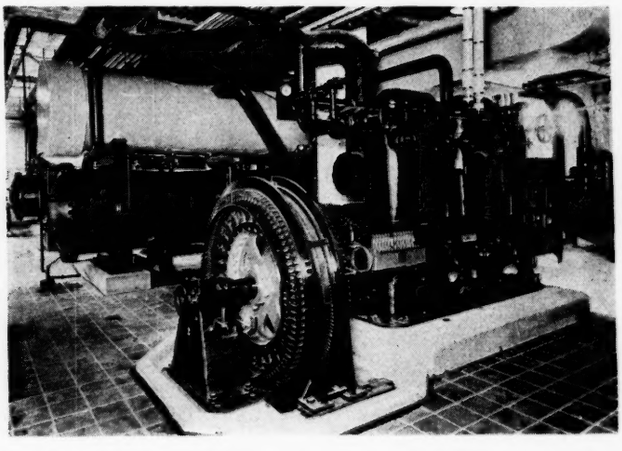
The ductwork in the corridors was concealed by changing the contour of the ceiling from rectangular to elliptical. This required new lighting fixtures for each corridor where this change was made. Numerous ornamental pilasters and drop beams were removed from the corridor space, and the location of others changed.

Controls

The control system for the 70 separate units is of the pneumatic type and provides for all functions of the system.

Generally there are two thermostats located in each zone. These thermostats reset a remote adjustable insertion thermostat located in the fan discharge. A throwover switch is provided so that either thermostat can reset the fan discharge instrument. As the temperature of the room increases, the duct thermostat is reset automatically for a lower temperature to compensate for the increased room temperature.

The remote adjustable duct thermostat operates the bypass and return air dampers, a valve on the steam connection to the reheater, and another valve in the chilled water lines supplying the coil with cold water. On a fall in temperature, the thermostat at the fan discharge opens the bypass. If the temperature continues to decrease, the valve on the reheater opens to supply steam to the reheater coil. If the temperature contin-



(Left) Filing room of the library is air conditioned 24 hr. a day the year 'round. Note the horizontal outlets and plaques supplying conditioned air. (Right) No. 2 compressor, cooler and condenser. Each compressor such as this is equipped with bypasses for capacity reduction without changing the machine speed or decreasing the supply of condenser water.

ues to drop further, the valve on the cold water line to the cooler is shut off. This entire operation is reversed on a rise in temperature.

For winter operation a thermostat has been installed in the cold air intake controlling the first preheater valve. A second thermostat is installed to control the second preheater so that the temperature of the entering air is regulated before striking the humidifier sprays. The sprays are controlled by two humidistats located adjacent to the above mentioned thermostats and connected through a throwover switch to a reverse valve in the spray line so that either humidistat can be used to operate the sprays. Each zone is so arranged that the spray water valve and fresh air damper will close when the fan is shut down.

In some instances, the outside thermostat has been made a two-point instrument, one point operating the preheater valve and the second point controlling a valve in the main supply line carrying water to the humidifying sprays. The second point of the thermostat will be set at the temperature at which moisture will begin to appear on the windows and when this temperature is reached, will automatically shut the sprays off. That temperature will be around 20°.

The radiators in the rooms in which the two pilot thermostats are located, are also controlled by these thermostats so that the proper temperature conditions can be maintained here. All other radiators are equipped with thermostatic valves.

The individual discharges into each room have been supplied with manually operated dampers. In order to provide the correct quantity of air in the various locations, regardless of the position of these dampers, a static pressure damper and regulator have been arranged in each fan discharge.

The units are provided with a special device to reverse the action of the bypass and return air dampers in the winter to force all air through the reheater for quick heating in the morning. This is accomplished automatically so that the control functions on its normal cycle as soon as the building is brought up to temperature.

In ten of the larger zones duct thermostats and humidistats were used in the return air ducts instead of the room type located in the conditioned area. Whenever the fans are operated, regardless of the season, a solenoid air valve opens the fresh air damper.

Seventh Floor System

The contract for conditioning the seventh floor of the building was awarded when this addition was made to the building. This floor, being entirely unshaded, required more refrigeration than most of the other floors. It is divided into 11 zones, making 81 in the whole building. The conditioners are supplied with chilled water through the same mains as the other conditioners. The original refrigeration for this system was supplied by two York water cooling systems similar to those included in the main contract but somewhat smaller in size.

The compressors in these systems are vertical single acting machines, 13½ in. x 13 in., and having two cylinders each. They are driven by two synchronous motors, each rated at 175 hp. Motor generator sets for motor excitation and automatic starting panels were included. The two condensers and the two water coolers are both of the shell-and-tube construction, having diameters of 38 in. and lengths of 16 ft.

Liquid recirculating pumps were also included in these two water cooling systems. Two 400-g.p.m. pumps were used to circulate the chilled water but with the installation of the main system, all cold water pumps have been connected to a common header and one large cold water distribution system is used. Thus, depending on the load conditions, various combinations of water cooling units and circulating pumps may be used.

Cooling Towers

When the main contract was awarded another contract was let for constructing a two-story building and the cooling towers above this. The building itself is approximately 50 ft. square and is located in the west court of the main building. It is similar in construction to the main building, that is concrete on structural steel. The first two floors of the building are completely finished and equipped with an air conditioning unit obtaining cold water from the central system. This space is to be utilized for film storage.

Four forced draft cooling towers were placed on this building and for cooling the condenser water from the refrigeration machinery. The shells of the towers are constructed of 3/16-in. copper bearing steel plate, reinforced with angles. Each tower is 34 ft. 10 in. high, 16 ft. wide, and 19 ft. deep. Four 1,000-g.p.m. pumps driven by 40-hp. motors, located in the machinery room of the main building, circulate water through the towers. With a wet bulb of 78°, each tower will cool 1,000 g.p.m. from 95° to 85°.

Air is pulled through the louvers below the tower shells by eight multi-blade disc type fans, 7 ft. in diameter. Each is driven by a 10-hp. splashproof induction motor. The air is discharged into the tower plenum and upward through the cooling bars arranged in staggered rows. These bars are of Tidewater cypress and are copper nailed. The cooling surface assembly fills the entire horizontal area of each tower.

The water distributing system of each tower is located just above the cooling surfaces and consists of one 8-in. main header with branch arms which distributes the warm water over the surface. Above the distributing arrangement and about four feet below the top of the tower stack, the drift eliminator assembly, consisting of triple tier cypress boards, is located. These prevent the escape of entrained moisture. Collecting basins welded to 9-in. channel sides are located below the towers. The outlet is a 10-in. connection and is provided with air-excluding suction head and strainer.

A complete exhaust system with duct connections extending above the roof was installed to remove the heat from the refrigerating machinery room, and disc type exhaust fans were installed in each toilet.

(Concluded on page 70)

Industry and Government Join in Promoting New Nationwide Series of Home Shows

Manufacturers' Housing Display Council and FHA initiate new effort to develop new construction; Economic Recovery Committee proposes plan for building 750,000 homes per year with private capital

OPENING of one of the new National Home Shows in Baltimore, beginning January 4, will mark the inauguration of another important step in the program further to speed up the awakening building industry to a point where idle construction labor will be employed and construction material factories will be operating at something like capacity. This latest move is the first large scale effort of its kind to be promoted by the active joint efforts of both the construction material and equipment industry and the housing agencies of the Federal government.

The co-sponsors of this series of nationwide National Home Shows are the Manufacturers' Housing Display Council, composed of a group of about 150 national manufacturers of building products and equipment, and FHA. In each city in which shows are to be conducted, local real estate boards, better housing committees, and civic organizations will participate. Each show will be financed locally. The promotion work will be done by men experienced in this type of exposition. Exhibits will be limited to manufacturers and distributors of building materials and equipment, and home furnishings. Space rental rates will be kept at the lowest possible minimum. Each show will be in operation not less than eight days, and not more than fifteen days, except in cities having a population in excess of 500,000. The principal objective of the shows will be to develop new home construction projects, but remodelling will be featured, too.

The Federal Housing Administration will participate in each show, whose plan of operation it has approved, by the installation of an extensive and unique exhibit, the purpose of which will be to educate Home Show spectators in the advantages now being offered for new home construction and remodelling. Each exhibit unit of the FHA will comprise two large entrance blocks of modern design bearing huge letters—FHA; cylindrical pylons or talking towers 17 ft. high bearing the FHA insignia and message. These pylons will feature photographs or models of houses that can be built under the insured mortgage plan, and space will be available where plans and specifications of these houses can be distributed. The talking towers will also include electrical transcription records which will broadcast information on the various provisions of the National Housing Act as well as talks on modern building materials and housing equipment; an information booth, and other features.

The first National Home Show will open in Baltimore, January 4, and continue through January 11. The second show is scheduled for San Diego, where the opening will take place on January 15 in connection with the reopening of America's Exposition in that city. Plans are also under way to present shows in Kansas City, Philadelphia, Buffalo, Houston, Oakland, Miami, Minneapolis, Louisville, Milwaukee, Indianapolis, and Boston.[1]

[1]H. A. Guthrie, of the FHA, is secretary of the Manufacturers' Housing Display Council, and further information desired regarding shows or exhibits may be obtained by addressing him at Washington, D. C.

Among the manufacturing executives who make up the personnel of the Manufacturers' Housing Display Council are (left) Marshall Adams, director sales promotion, American Radiator & Standard Sanitary Corporation; (center) C. N. Tull, president, Spencer Heater Company, and (right) C. A. Dunham, president, C. A. Dunham Company.

Membership on the Council of a large number of men prominent in the heating, ventilating, and air conditioning industry indicates that this important part of the construction field will be well represented at the exhibits. Among the Council's personnel are:

Marshall Adams, American Radiator; L. Stockstrom, American Stove; C. W. Bennett, American Sheet & Tinplate; A. K. Barnes, Armstrong Cork; J. H. Hirsch, Automatic Burner; H. N. Mallon, Bryant Heater; George D. Crabbs, Philip Carey; R. C. Goddard, Combustioneer; Bertram B. Caddle, Copper & Brass Research; Russell G. Creviston, Crane; C. A. Dunham, C. A. Dunham Co.; E. G. Biechler, Frigidaire; Edward H. Muehlenbroch, Holland Furnace; J. M. Frank, Ilg; R. H. M. Robinson, Insulite; T. H. Banfield, Iron Fireman; C. T. Burg, Iron Fireman; W. C. Tenwick, Iron Fireman; H. M. Shackelford, Johns-Manville; H. F. Johnson, S. C. Johnson & Son; Walter Kohler, Sr., Kohler Co.; A. J. Fleischmann, May Oil Burner; Louis Kuehrn, Milcor Steel; H. W. Sweatt, Minneapolis-Honeywell; H. P. Mueller, L. J. Mueller Furnace Co.; Robert S. Waters, National Radiator; Herman W. Nelson, Herman Nelson; T. M. Girdler, Republic Steel; Richard S. Reynolds, Reynolds Corp.; D. Rait Richardson, Richardson & Boynton; W. G. Langford, Richmond Radiator; Harry C. Howard, Round Oak; A. P. Brill, Ruud Manufacturing; R. M. Sherman, Silent Glow; E. W. Smith, H. B. Smith Co.; C. N. Tull, Spencer Heater; H. A. Thrush, H. A. Thrush & Co.; W. F. Rockwell, Timken Silent Automatic; H. T. Cole, U. S. Radiator; G. A. Berghoff, Wayne Oil Burner; Benjamin Weil, Weil-McLain; Reese Mills, Westinghouse; C. U. Williams, Williams Oil-O-Matic.

Committee Asks Backing for Building Program

A nationwide home building program contemplating the construction of 8 million low and moderate cost homes during the next ten years, with private capital doing 85% of the job, was submitted to President Roosevelt by the Committee for Economic Recovery, Inc.

The committee, which is composed of business men representing varied fields of enterprise, made public November 23 a summary of the program, together with a detailed analytical and statistical report. The basic idea of the program, according to Allie S. Freed, chairman of the committee, is the creation of a huge home building industry geared to construct 750,000 new homes each year for the next ten years. According to the committee, it may be expected to absorb at least 4 million of the present 10 million of unemployed, as well as to stimulate other industries and retail trade.

The committee hopes to obtain the aggressive backing of the Roosevelt administration for the proposed program. The summary and report point out that it is in line with President Roosevelt's declarations favoring social security and high standards of living.

For its success, the report says, such a program will require close and harmonious cooperation between private and public agencies. It suggests that the Department of Commerce be authorized to do the "promotion work" in connection with the program, with such governmental agencies as the HOLC, FHA, RFC and the Federal Savings and Loan Associations cooperating with private capital in the financing operations.

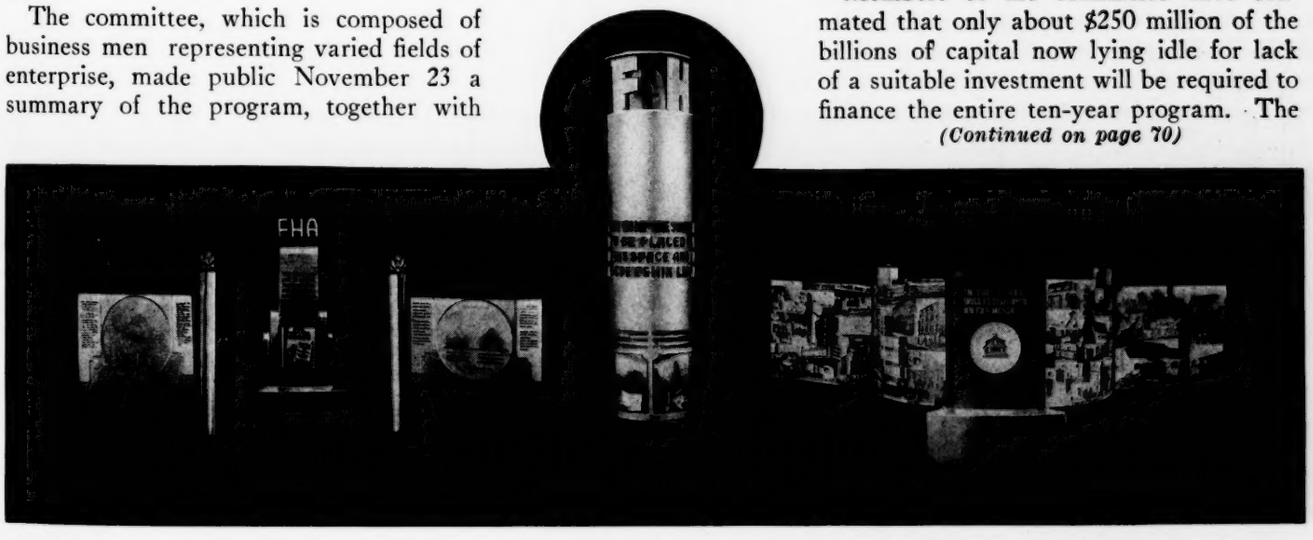
The program visualizes the building and sale of homes selling from $2,500 to $6,000. To make such prices possible, there must be a drastic revision of present methods of home financing. The plan contemplates action by the FHA to make available government guaranteed mortgages at a cost of ¼ of 1% of the depreciating balance. It would also reduce to 10% of the price the cash-down payments, and interest rates, covering all charges, would be at a minimum of 4½%.

Establishment of such a financial program by government agencies concerned with home building, the committee believes, would automatically, by force of competition, bring about establishment of a similar scale by private capital.

Under the proposed plan, private capital would build all homes for income groups over $1,000 a year, covering about 85% of the program. Public housing, under the direction of national and local units, would take care of the income groups below $1,000.

Members of the committee have estimated that only about $250 million of the billions of capital now lying idle for lack of a suitable investment will be required to finance the entire ten-year program. The

(Continued on page 70)



Displays which FHA and the Manufacturers' Housing Display Council will furnish to Home Shows. The tower in the center, which is 17 ft. high and 3½ ft. in diameter, is equipped with an electrical transcription device to broadcast talks on various phases of building.

New York's New Code Sets Up Safety Requirements for Air Conditioning Systems

AT the same time work was under way on the formation of Standards for Testing and Rating Air Conditioning Equipment by a manufacturer group, and while another group in Chicago was formulating standards for that city, a third project has been under way in New York, with safety as the primary consideration. This is the Proposed Revision of Chapter 10 of the Code of Ordinances of the City of New York Relating to Refrigerating Systems. It has been prepared by the Bureau of Combustibles of the New York Fire Department of which John J. McElligott is Fire Chief and Commissioner, and under the immediate supervision of C. K. Michaels, engineering inspector, Bureau of Combustibles. The proposed changes have undergone a second revision in order to bring them up to date and especially to cover air conditioning systems which the old code did not include. The new code lists, for example, many new refrigerants not included in the old code.

In general, the code applies to refrigeration systems, both domestic and commercial, and air conditioning for comfort. Conditioning for process constitutes an exception to several rules, and otherwise is not mentioned and therefore presumably not covered in the code.

At the time of writing this, the code has not finally been adopted, but a hearing has been scheduled and it is quite probable that the code will shortly become a part of the city ordinances.

C. K. Michaels, engineering inspector, Bureau of Combustibles, New York Fire Department, New York

Inasmuch as air conditioning is inextricably tied up with refrigerating systems in this code, and since any ordinance adopted by New York may be widely copied, a fairly comprehensive review of this code, with liberal quotations from it, is included here.

Definitions

The general provisions of the Ordinance define a refrigerating system and its various parts. In addition, the different methods of refrigeration are defined, and are shown in Fig. 1 which also illustrates some of them. Incidentally, *air conditioning* is defined as the cooling of air for human comfort by means of a refrigerating system and/or brine and/or water.[1]

Detailed definitions of various types of buildings include *public buildings*, defined as places in which persons congregate for civic, political, educational, religious, or recreational purposes, or to receive medical, charitable, or other care, or in which persons are held or detained by reason of public or civic duty. *Residence buildings* are those in which sleeping accommodations are provided, except those which may be classed as public buildings. *Business buildings* are those which are not public or residence buildings, and include offices, stores, markets, restaurants, warehouses, depots, garages, factories, and laboratories. *Buildings of mixed occupancy* are those in which a building is occupied or used for different purposes in different parts, and if there are conflicting provisions the requirements securing the greater safety shall apply. A building of doubtful classification is to have its status fixed by the Superintendent of Buildings.

Fees, Permits, and Licenses

The Ordinance provides for annual fees for each refrigerating system as follows:

A system containing over 1,000 lb. of refrigeration, $20 per year; from 100 to 1,000 lb., $10; from 20 to 100 lb., $5; from 6 to 20 lb., $2, and less than 6 lb., $1.[2]

No person can maintain or operate a refrigerating system without a permit, but a permit will not be required for a system containing 6 lb. or less of refrigerant, and located in a residence with not more than two families. An annual fee of $100 is to be paid by each licensee who wishes to install, service, or repair, or dismantle a refrigerating system, and no such work can be done on a refrigerating system except by a person, partnership, or corporation who has obtained such a license. The permit cannot be issued until the installer has filed notice with the Fire Commissioner that the installation of the system has been made in accordance with the Ordinance. Only those refrigerants specified in the code can be maintained or operated unless a special permit is issued by the Fire Commissioner.

Operating Supervision

The requirements for supervision have been carefully detailed and require that no refrigerating system containing more than 100 lb. of refrigerant shall be operated in any building unless it is under the personal supervision of a licensed engineer or a person who has obtained a certificate of qualification to operate such a system from the Board of Examiners. For a fully automatic refrigerating system with from 100 to 200 lb. of refrigerant, the occasional inspection of a licensed engineer or certified and qualified person shall be required each 24 hr. Such a person cannot, however, supervise or operate refrigerating equipment in more than one building, except those interconnected and in the same city block.

All operators must pay an annual license of $2 with an initial fee of $10.

Unit systems are those which can be moved from one

[1] *Editor's note*—Compare this with the definition in the American Standard ASRE Safety Code: "Air conditioning system—A refrigerating system for the purification and/or control of temperature and/or humidity of air."

[2] *Editor's note*—These divisions roughly correspond to the capacities of large central systems, small systems, room units, and household kitchen refrigerators, respectively.

location to another in the same building by persons other than licensed installers, but can only be originally installed, serviced and/or repaired or dismantled by a licensed installer.

Table 1 shows the classification of refrigerants as to whether they are irritant or non-irritant, flammable or non-flammable.

Rules on Refrigerants

No refrigerating system can be installed in or on the stairways, halls, lobbies, entrances, or auditoriums of public buildings, residence buildings, or business buildings or in the exits of public buildings. No piping carrying refrigerant can be installed throughout or from one room to another in any public, residence, or business building, except that this is permitted from one room to another in residences and business buildings in certain cases where the spaces concerned are occupied by one tenant.

In both residence and business buildings the refrigerating system must be confined to the space occupied by a single tenant on any one floor. Exceptions to this are made, however, in the case of buildings used exclusively for ice-making, cold storage, candy-making, and similar applications where not more than 100 persons are employed above the first floor under certain conditions. No refrigerating system employing an irritant and/or flammable refrigerant using the direct method and/or the indirect open spray method of refrigeration for air conditioning shall be used in a business building, except in buildings used exclusively for ice-making, cold storage warehouse, meat packing, slaughter house, ice cream manufacture, and similar applications, when not more than 100 persons are employed above the first floor. In addition, the same provisions apply to refrigerating systems using the direct method of refrigeration, employing more than 500 lb. of refrigeration per system for air conditioning in business buildings, excepting those outlined above. In addition, in business buildings no refrigerating system or systems for sale or demonstration, may be installed, stored, or operated in a department store, excepting a unit system using not more than 20 lb. of refrigerant located in a room cut off from the rest of the building by tight partitions and doors. In the case of residences, no refrigerating system employing the direct method of refrigeration in a two-family dwelling can be installed for the common use of both families.

In residential buildings no system employing an irritant and/or flammable refrigerant shall be used for air conditioning except by the double indirect, open spray method and/or the double indirect closed surface method.

No refrigerating system containing an irritant and/or flammable refrigerant, except the unit system of the sealed type, can be located in an exhibition hall such as Grand Central Palace, Madison Square Garden, or an armory. With the exception of unit systems of the sealed type with less than 6 lb. of an irritant and/or flammable refrigerant, or systems used exclusively for research purposes in schools or colleges, no refrigerating system employing an irritant and/or flammable refrigerant can be installed and operated in a public building.

No refrigerating system with more than 20 lb. of a non-irritant and non-flammable refrigerant can be used in a refrigerating system by the direct method of refrigeration for air conditioning in a public building or department store. No such refrigerating system can be used in a department store other than in a vapor proof machinery room used for no other purpose, and in which no open flames are present.

In residences no refrigerating system using the direct method of refrigeration employing more than 500 lb. of refrigerant in any one system can be installed for air conditioning. If the system is of the direct type and has more than 50 lb. of refrigerant it cannot be installed for air conditioning sleeping quarters in a residence building.

Brine or water cooled by an irritant and/or flammable refrigerant may be obtained from a system external to a public or residential building for air conditioning such a building, provided the double indirect open spray method of refrigeration and/or the double indirect closed surface method of refrigeration is used. In the case of public buildings, though, this cooling of brine or water must be done in a space isolated from the building.

TABLE 1. CLASSIFICATION OF REFRIGERANTS AND REQUIRED RELIEF VALVE SETTINGS

Refrigerant	Pressure Relief Valve To Be Set At Not More Than, Lb. Per Sq. In.	
	High Pressure Side	Low Pressure Side
Irritant and Flammable		
Ammonia	300	150
Dichloroethylene	15	15
Isopropyl chloride	35	15
Methyl chloride	200	100
Methyl formate	30	15
Non-Irritant and Flammable		
Butane	100	30
Ethane	1100	600
Ethyl chloride	75	25
Isobutane	135	60
Propane	250	150
Irritant and Non-Flammable		
Sulphur-dioxide	175	100
Non-Irritant and Non-Flammable		
Carbon dioxide	1500	1000
Dichlorodifluoromethane*	225	125
Dichlorotetrafluoroethane*	75	30
Dichloromethane*	20	15
Dichloromonofluoromethane*	75	25
Trichloromonofluoromethane*	35	15
Trichlorotrifluoroethane*	15	15

*Refrigerants so marked, when used in a department store in which there is an open flame, require hood over flame-producing apparatus; otherwise these refrigerants are classified as irritant. See text.

No ducts shall be installed in a public building or department store from one room to another for carrying air from a system employing the direct method of refrigeration. The same provision applies to business buildings, provided the indirect closed surface and/or the double indirect open spray method is used.

In department stores using any refrigerant marked with an asterisk in Table 1, and in which there is an open flame, the flame-producing apparatus shall be provided with a hood to remove the products of combustion. Otherwise the refrigerant will be classed as an irritant for such locations. However, flames made by matches, cigarette lighters, small alcohol lamps, and similar devices are not considered as open flames.

No refrigerating system employing more than 2 lb. of a hydrocarbon refrigerant[3] shall be installed or operated in any building. Refrigerating machinery rooms in which an irritant refrigerant is employed must have tight-fitting, self-closing doors, and no partitions which open to permit the passage of the refrigerant to other rooms. In addition, air washers, blowers, ducts, etc., used for air conditioning shall be partitioned off from the refrigerating machinery room or made airtight to prevent escaped refrigerant in the machinery room from entering the air conditioning system.

Ventilation of Refrigeration Machinery Rooms

The following provisions are quoted directly from the provisions applying to ventilation of machinery rooms. Table 2, however, is somewhat abridged from the complete table given in the Ordinance.

"(a) Each refrigerating machinery room shall be provided with means for ventilation to the outer air. The ventilation shall consist of a window or windows opening directly to the outer air, or mechanical means capable of exhausting the foul air from the room to the outer air.

[3]*Editor's note*—See Table 1. Hydrocarbon refrigerants mentioned are butane, ethane, isobutane, and propane.

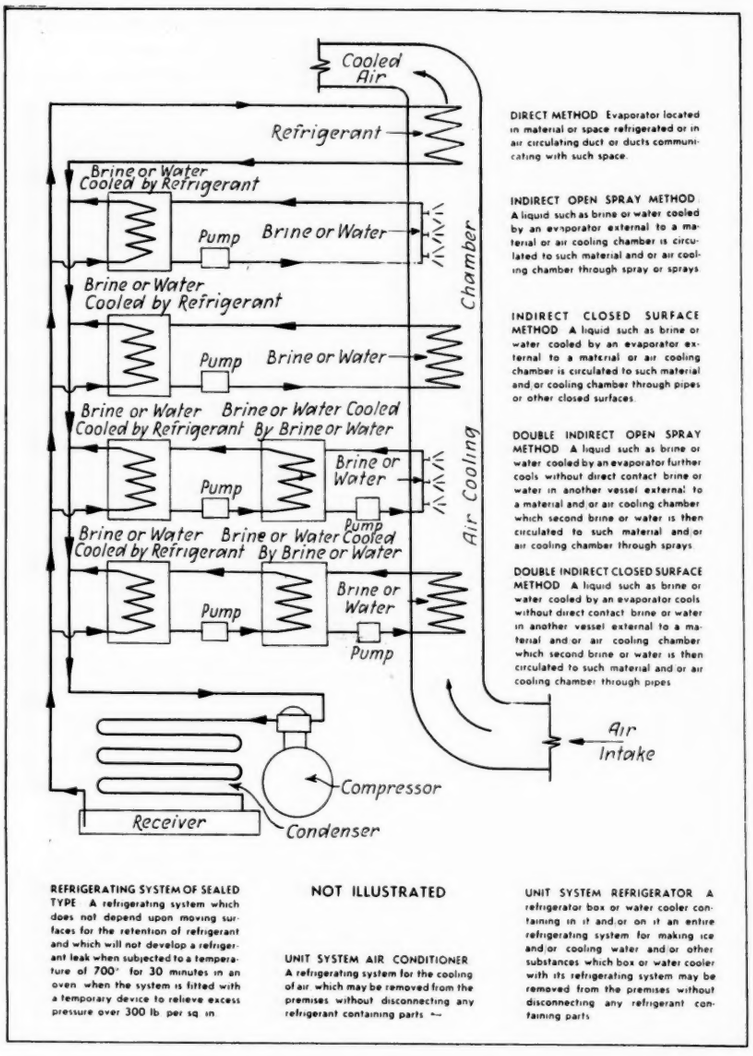

Cooled Air
Refrigerant
Brine or Water Cooled by Refrigerant
Pump
Brine or Water
Chamber
Brine or Water Cooled by Refrigerant
Pump
Brine or Water
Brine or Water Cooled by Refrigerant
Brine or Water Cooled By Brine or Water
Pump
Brine or Water
Pump
Air Cooling
Brine or Water Cooled by Refrigerant
Brine or Water Cooled By Brine or Water
Pump
Brine or Water
Pump
Air Intake
Compressor
Receiver
Condenser
DIRECT METHOD Evaporator located in material or space refrigerated or in air circulating duct or ducts communicating with such space.
INDIRECT OPEN SPRAY METHOD A liquid such as brine or water cooled by an evaporator external to a material or air cooling chamber is circulated to such material and or air cooling chamber through spray or sprays
INDIRECT CLOSED SURFACE METHOD A liquid such as brine or water cooled by an evaporator external to a material or air cooling chamber is circulated to such material and or cooling chamber through pipes or other closed surfaces.
DOUBLE INDIRECT OPEN SPRAY METHOD A liquid such as brine or water cooled by an evaporator further cools without direct contact brine or water in another vessel external to a material and or air cooling chamber which second brine or water is then circulated to such material and or air cooling chamber through sprays
DOUBLE INDIRECT CLOSED SURFACE METHOD A liquid such as brine or water cooled by an evaporator cools without direct contact brine or water in another vessel external to a material and or air cooling chamber which second brine or water is then circulated to such material and or air cooling chamber through pipes
REFRIGERATING SYSTEM OF SEALED TYPE A refrigerating system which does not depend upon moving surfaces for the retention of refrigerant and which will not develop a refrigerant leak when subjected to a temperature of 700° for 30 minutes in an oven when the system is fitted with a temporary device to relieve excess pressure over 300 lb. per sq. in.
NOT ILLUSTRATED
UNIT SYSTEM AIR CONDITIONER A refrigerating system for the cooling of air which may be removed from the premises without disconnecting any refrigerant containing parts
UNIT SYSTEM REFRIGERATOR A refrigerator box or water cooler containing in it and or on it an entire refrigerating system for making ice and or cooling water and or other substances which box or water cooler with its refrigerating system may be removed from the premises without disconnecting any refrigerant containing parts

Fig. 1. Classification of refrigerating systems in the New York City ordinance. Classification shows schematic drawing as well as definitions for five of the types, with three others defined but not illustrated.

"(b) When a window or windows are used the total area provided shall not be less than that specified in Table 2.

"(c) When mechanical means are used they shall consist of a power driven exhaust fan of the enclosed case blower type which shall be capable of removing from the refrigerating machinery room the amount of air specified in Table 2. The inlet to the fan shall be located near the refrigerating equipment. The outlet from the fan shall terminate outside the building. When air flues are used on either the inlet or discharge side of the fan they shall each have an area not less than that specified in Table 2. Sharp bends in the run of the flues shall be avoided. Systems containing more than 100 lb. of refrigeration shall have the control for such mechanical means of ventilation located outside of the refrigerating machinery room."

Other provisions of the Ordinance include those regarding open flames, requirements for electrical equipment, and those on the testing of the system.

Piping and Its Erection

Requirements for piping, tubing, fittings, supports, charging and air ducts are detailed, one being that the material used in piping or tubing and fittings shall be unaffected by the refrigerant used. All soldered joints must be protected against vibration strains, and no soldered joints will be permitted in discharge, liquid, or suction mains of more than 2⅛ in. outside diameter erected on the premises.

Refrigerating piping or tubing may not be placed in a hall, lobby, stairway, elevator, or dumbwaiter shaft, but it may pass across a hallway if there are no joints in this section, and if it be contained in a rigid conduit.

Miscellaneous

The following miscellaneous provisions from Section 224 of the Ordinance are quoted verbatim:

"(g) Intake of outside air shall be from outside the building not less than 6 ft. above the grade and shall be protected by suitable metal screens and substantial automatic shutters or doors, except in a one-family dwelling.

"(h) In recirculating systems no air shall be recirculated from any space in which operations are carried on that produce or result in objectional quantities of vapors, flyings, or dust.

"(i) Air filters of combustible fibrous materials will not be permitted.

"(j) When oil is used in air filters for the purpose of eliminating impurities, it shall have a minimum flash point of 300°. Such oil filter shall be used on return air only.

"(k) When such filters are of the immersion type where the oil tank into which the screens are lowered constitute a part of the apparatus, the tank shall be of substantial metal construction, properly supported, and shall be equipped with tight fitting covers. Covers must be kept on when tank is not in use. Tank shall be provided with suitable drains to discharge the contents of the oil into a closed tank of substantial construction vented to the outside of the building

"(l) When the screens are removed for cleaning, the cleaning shall be done either in a separate room constructed of approved fire-resistive materials or outside of the building.

"(m) Any combustible material of the building within 6 in. of metal ducts shall be protected by non-combustible material.

"(n) Ducts shall be made of non-combustible materials. No combustible linings shall be used. Where ducts pass through combustible floors that portion of the duct shall be encased in approved fire-resistive materials.

"(o) When ducts pass through floors, substan-

TABLE 2. REQUIREMENTS FOR VENTILATION OF REFRIGERATION MACHINERY ROOMS (ABRIDGED)

	Lb. of Refrigerant In System	C.F.M. Discharge For Mech. System	Sq. Ft. Flue Area For Mech. System	Window or Door Area in Sq. Ft., for One Side Only
Up to	20	150	¼	4
	50	250	1/3	6
	100	400	½	10
	150	550	2/3	12½
	200	680	2/3	14
	250	800	1	15
	300	900	1	17
	400	1,100	1¼	20
	500	1,275	1¼	22
	600	1,450	1½	24
	700	1,630	1½	26
	800	1,800	2	28
	1,000	2,050	2	31
	1,250	2,250	2¼	33
	2,500	3,300	2½	43
	3,000	3,700	3	48
	4,000	4,600	3¾	55
	5,000	5,500	4½	62
	6,000	6,300	5	68
	7,000	7,200	5½	74
	8,000	8,000	5¾	80
	9,000	8,700	6¼	85
	10,000	9,500	6½	90
	20,000	15,200	8¼	130
	40,000	20,500	9½	155
	45,000	21,500	9¾	160

tial and reliable automatic dampers shall be provided at outlet and inlet openings and at branch duct connections to such ducts. Bearings of such dampers shall be of non-corrodible material.

"(p) When ducts or the outlets from or inlets to same pass through fire walls they shall be provided with approved automatic fire doors or shutters on both sides of the wall through which they pass.

"(q) Joints between ducts and floors, walls or partitions, shall be made tight by means of non-combustible material."

Safety Devices

All shell type apparatus of more than 6 in. in diameter, containing refrigerant in the liquid phase, shall be protected from over pressure by a spring loaded pressure relief valve. A fusible plug will not be accepted in lieu of a spring loaded pressure relief valve where such valves are required.

A rupture member not less than ¼ in. in diameter may be substituted for the pressure relief valve in a carbon dioxide system or a system normally operating below atmospheric pressure.

No shut-off valve shall be located between a pressure relief valve and that part of the system protected thereby, unless two pressure relief valves of the required size are used and so arranged that only one pressure relief valve can be cut off for repair purposes at any one time.

The discharge from pressure relief valves, when an irritant and/or flammable refrigerant is used, must be piped to the outside of the building with the outlet orifice turned downward. The discharge from more than one relief valve may be run into a common header, the area of which shall be not less than the combined area of the pipes connected thereto.

Pressure relief valves will depend on the quantity of refrigerant in the system as follows:

Over 1,000 lb., 1 in.; 100 to 1,000 lb., ½ in.; 20 to 100 lb., ¼ in., and up to 20 lb., ¼ in. Such pressure relief valves shall be placed above the liquid refrigerant level and set to relieve at not more than the values in Table 1.

Effective Temperatures as an Index of Air Conditioning Need

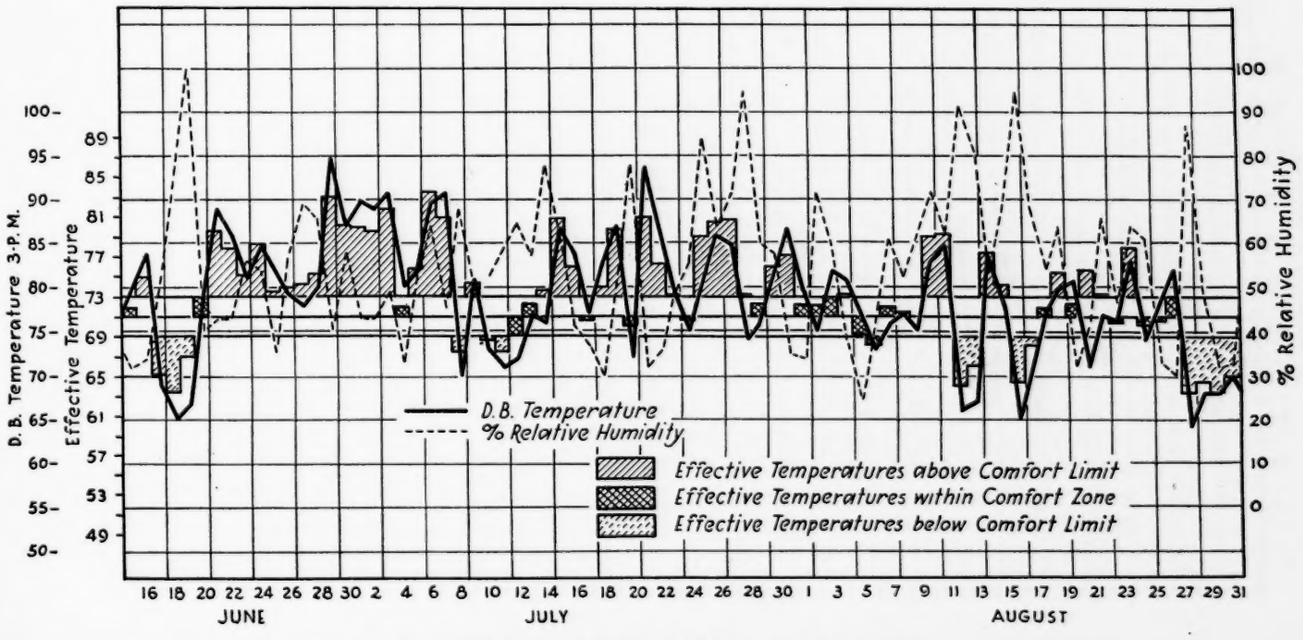
By J. E. HITLIN and G. W. HART

A STUDY of air conditions in any specific location leads invariably to a chart of one kind or another. The problem is to find a method of graphically representing the conditions in which we are most interested in as clear and concise a manner as possible. To show the degree of severity and frequency of occurrence of conditions outside the comfort zone limits over a period of time is the objective of such a chart.

The terms in which air conditions are expressed are the most common variable found in such analyses. Since "effective" temperature has been developed to accurately reflect the composite effect of wet and dry bulb temperature and since the "comfort zone" has been defined in terms of "effective" temperature, they have been selected as the basis of this study.

The air motion condition has been considered to be constant at 20 to 30 f.p.m. as would be the case were this outdoor air brought indoors without change in sensible or latent heat and distributed at that low velocity.

Below is presented a chart using "effective" temperatures as the criterion for gauging the departure from comfort conditions. This particular chart shows outdoor weather conditions as recorded by the United States Weather Bureau at Whitehall Building, New York City, at 3 p.m. during the months of June, July, and August, 1934, and is offered merely as an example of the application of this method of analysis.



Air conditions in New York during summer of 1934.

GETTING DOWN TO FUNDAMENTALS

8—Transmitted Heat Calculation—Nature and Accuracy of the Formula and Coefficients

HAVING data available to determine values of U† is sufficient to permit practical calculations but it is not sufficient in understanding fundamentals. The nature of these values should be made clear for unless this is the case the values themselves can be, and often are, grossly misused. There are two principal causes of the misunderstandings, both of which have to do with the underlying theory upon which equation (1) is based. The best way to see clearly the nature of the values and thus insure proper use is to understand fully the fundamentals of the theory involved and to know how the values themselves are determined. To accomplish this we must go back to the theory.

Fundamental Requirements

The cross-hatched part of Fig. 1 shows a piece of solid material, let it be wood, glass, brick, plaster or any other solid. Assume that the air temperature t_i on the one side is higher than the temperature t_o on the other side. Because of this the temperature of the surface facing t_i will gradually become higher than the surface temperature of that side facing t_o. Heat will therefore flow through the solid in the direction of the arrow. The amount of heat flowing will depend on the difference in the two temperatures t_i and t_o. Moreover the amount flowing will also depend on the difference in the temperatures of the two surfaces of the solid. This is the same as saying that as long as the surface temperatures of the solid are changing the amount of heat flowing will also change. If the surface temperatures of the solid and the temperatures t_i and t_o are kept steady for a long enough period, the amount of heat flowing will become steady or constant and will remain so as long as the temperatures are also kept constant.

Now consider another set of facts. As the heat attempts to enter the solid material on the surface facing t_i it meets with a certain amount of resistance and has to be forced into the material. Then as it passes through the solid it continues to meet with more resistance and the same is true as it passes out of the solid and into the air on the surface facing t_o. It has been shown that the amount of resistance encountered at the surfaces depends largely on the *nature* of the surface, but little on the kind of material, and is largely independent of the temperatures of the surface. On the other hand the amount of resistance encountered as the heat passes through the solid substance depends very greatly on the nature of the material, its dimensions, its density, and to a small extent on its temperature. The sum of all these resistances encountered greatly affects the amount of heat flowing.

It was long ago shown mathematically that, *during the time when the temperatures and amount of heat flowing are kept steady*, the following is true:

Heat entering one surface = heat flowing through solid = heat leaving other surface.

†In previous articles in this series the nature and direction of flow of the heat quantities on which the usual estimate is made were described. They are (a) transmitted heat, (b) heat from filtration air, and (c) heat from ventilation air. These quantities can be expressed mathematically in the following equations:

$$\text{Transmitted Heat} = H = AU\,(t_i - t_o) \qquad (1)$$

$$\text{Heat from Filtration Air} = F = \frac{C(t_i - t_o)}{55} \qquad (2)$$

$$\text{Heat from Ventilation Air} = V = \frac{C_v(t_i - t_o)}{55} \qquad (3)$$

In these equations: H, F, and V are all in B.t.u. per hour:

A = Area, sq. ft. of surface through which heat passes
U = The transmission coefficient, air to air
C = Volume of filtration air flowing, cu. ft. per hr.
C_v = Volume of filtration air flowing, cu. ft. per hr.
t_i = Temperature of indoor air, °F.
t_o = Temperature of outdoor air, °F.
1/55 = 0.018 = heat to raise 1 cu. ft. of air at 70° through 1°

Tables were presented indicating current ideas as to what values should be used for t_i and t_o under both summer and winter conditions. Methods of finding values of C in equation (2) and C_v in equation (3) were described, with tables. Thus all the necessary data for making calculations of the Heat from Filtration Air and the Heat from Ventilation Air have been presented.

We now proceed to an examination of the fundamentals surrounding the calculation of the Transmitted Heat, especially as accomplished by the use of equation (1). As values of t_i and t_o have been fixed, our principal consideration is to present suitable values of U, the transmission coefficient, air to air.

At that time a value for U, the coefficient with which we are concerned, can be determined by using the following rule:

$$\frac{1}{U} = \text{Inner Surface Resistance} + \text{Solid Resistance} + \text{Outer Surface Resistance.}$$

This gives the basis of a method upon which values of U can be determined, provided values of the resistances are found *under conditions where temperatures and resistances are kept steady.*

The same general rule applies regardless of what materials are considered, of how many materials are used, how they are put together in combinations, or the testing methods used in determining values of U. It is upon this general theory that all of our commonly used values of U for substitution in equation (1) are based. In general, testers, research workers and laboratory procedure have all recognized the requirement of the theory. Pains have been taken to see that the condition of steady flow was secured before making tests. It is notable that in their reports these testers have usually emphasized the fact that steady conditions were present and have also noted that in many cases it was necessary to artificially hold conditions steady *for several hours* before this condition could be achieved.

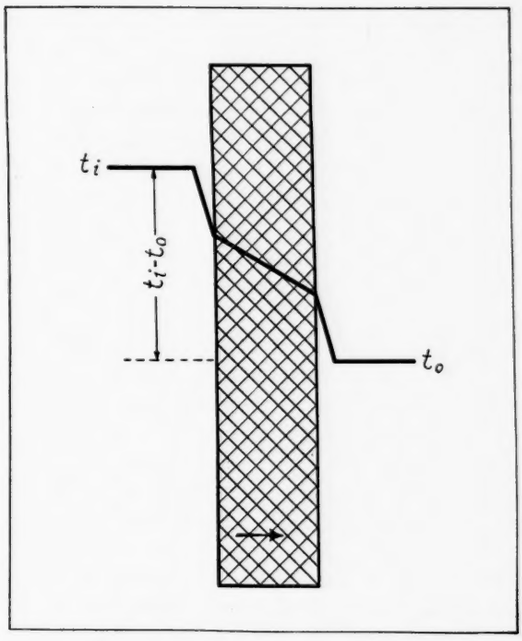


Fig. 1. Showing the drop in temperature of heat passing from a region of high temperature to one of lower temperature through some substance.

The results of such tests have been used to establish the values of U which are currently available for practical use whether in tables calculated or prepared by someone else, whether one makes his own calculations, or accepts the results of tests made on full scale constructions.

Accuracy of Results

Now we can ask the question—When we use such values of U what are we really calculating? The answer is that we are establishing the amount of Transmitted Heat under steady conditions of temperature on both sides of the material (or construction in question) and throughout the materials themselves. Consideration of both the fundamental theory and of the methods of arriving at the values of U commonly used can lead to no other conclusion. This is what we are dealing with so long as we use a calculating equation in the form of equation (1) and continue to accept the values of U for use in it as determined by the usual methods of test.

We can pursue this line of inquiry in several additional directions. One point worth discussing in order to determine how authentic our final calculations are, has to do with learning how nearly conditions of steady flow of heat are really set up in walls, roofs, windows, and similar constructions under actual operating conditions. Another is to inquire as to what we are really trying to determine when we make calculations of Transmitted Heat.

In connection with the first of these points, recall that investigators in laboratories have noted that considerable time is required in order to set up conditions which cause a steady flow of heat. They find it necessary to keep the air temperatures or the surface temperatures of the two sides of the material steady for some time before constant flow is achieved. The actual time varies with the material, its dimensions, and other factors. It is noteworthy that in heating or cooling practice no attempt is made to hold the temperature of the outside air steady, although constant temperature is attempted on the inside. Now it is well known and easily established that the outside air temperature changes greatly not only from season to season but daily and hourly as well. There is real reason to question, therefore, if the condition of steady flow on which the whole calculation is based is ever actually reached in practice in many building constructions, though it is probably approximated. Some study of this has been made both by the use of heat meters set up on existing constructions and by temperature measurements taken inside the materials of existing walls and on their surfaces. These studies have not been general enough, however, to warrant any conclusion being based on them or to permit the formulation of working rules. It is concludable however that in many localities and with many building constructions the condition of steady flow is never reached. It is for this reason that in connection with many situations arising in heating or air conditioning work the whole general theory of calculating Transmitted Heat by formulas similar to equation (1) has been repeatedly questioned.

Summer and Winter Calculations

On the positive side it is to be noted that regardless of the shortcomings, use of this formula has not met with any particular practical objections from the great majority of people who use it for heating calculations. They seem in fair agreement that so far as the heating season is concerned this formula and the values of U in common use give results which permit them to prepare estimates sufficiently accurate for their purposes. It has been most sharply questioned in connection with similar calculations for the summer cooling season. The principal objection is that the resulting figures are too

high and that equipment sized on that basis is overly large and therefore unnecessarily high in first cost.

This brings out clearly the difference in viewpoint between the sizing of winter equipment and summer equipment. Winter equipment is generally accepted as necessary and the usual school of thought holds that it is better to size it with reasonable generosity to be sure of meeting extremes of weather and to provide operating control to keep the capacity from causing overheating, than to skimp the job and risk failure of performance in cold spells. There is therefore little urge to adopt methods of calculating the Transmitted Heat which would reduce the size and capacity of the installed plant. This is particularly true because there is a considerable body of experience behind the calculations as usually made and a fair knowledge of how much capacity is required with given equipment and known operating methods. Summer equipment though is not yet accepted as necessary, first costs are still regarded as too high by many purchasers, and there is but a small body of experience built up to permit forming judgments. While the usual calculator does not want to risk failure he would like to keep first costs as low as possible. He feels therefore that if the method gives results too high it is a serious matter and should be corrected with all possible dispatch.

Here the matter rests at present with a difference of opinion as to the seriousness of the failure of the theory to meet practical desires and requirements. It is hard to see how anyone who gives close attention to the nature of the equation and to the sources of the values of the coefficient U available for use in it could fail to note that it holds several questionable elements in its makeup. At best it is an approximation, an estimating basis, nothing more. Certainly there is nothing inherently accurate in practical applications in the heat quantities obtained by this method of calculation.

Misusing the Equation

It is the failure to recognize this state of affairs which leads to the misuse of the equation. People persistently try to read into the equation, and hence into the estimates resulting from it, a degree of accuracy not there and also try to make use of it to calculate heat quantities when it is extremely questionable if the condition of steady flow is even remotely approached. In spite of the fact that the units commonly used set up the resulting heat quantity in B.t.u. per hour it does not follow that this quantity is real or that it actually flows in any given hour. Specifically, the equation should not be interpreted as really measuring the heat flow from a building at a particular hour for which observations of outside and inside temperature are taken. Yet this very thing is often done, in spite of the impossible results which may come from such a practice.

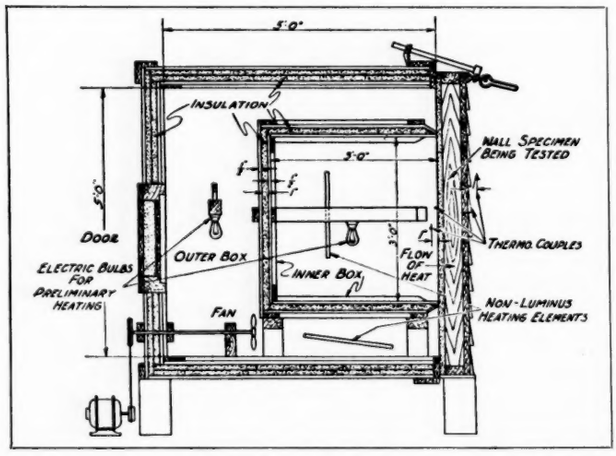


Fig. 2. Apparatus illustrating one method of finding the heat passing through a built-up wood frame wall. Guarded box method.

The equation and the coefficients commonly used should instead be understood in their true light, namely, as forming the basis of a reasonably simple method of estimating the quantity of heat flowing when only an estimate is desired. At best the method is questionable and undoubtedly inaccurate, but is better than no method at all. Used intelligently and properly as a basis for guiding judgment it can be made extremely useful. Used unintelligently it leads to ridiculous results.

Sources of Values for U

With the nature of equation (1) thus clarified and with its proper use and its limitations suggested, we can turn attention to means of securing coefficients U for use in it.

There are two methods of approach. One is by purely test methods and the other combines test data with calculations.

Tests without calculations involve the construction and testing of full scale models or tests taken on constructions in existing buildings. Obviously with all the types of construction possible and in more or less common use, a complete program of obtaining a full set of values of U would be lengthy in the extreme. Such work has gone on for many years but still has not subjected all types of construction to test.

Instead, the second method of obtaining suitable coefficients is the one commonly used. In order to understand where the coefficients come from and are developed it is necessary to extend the theory just stated for the simple construction as shown in Fig. 1. Applying exactly the same fundamental reasoning (with the same limitations) to a more complicated construction (one where there are several air spaces) the following mathematical statement results, expressing U in terms of its elements:

$$U = \frac{1}{\frac{1}{f_i} + \frac{1}{f_o} + \frac{x}{k} + \frac{x}{k_1} + \frac{1}{a_1} + \frac{1}{a_2} + \text{etc.}}$$

This form of equation can be used to compute the coefficient U for almost any type of construction as soon as suitable values are known for the several f factors, the several k factors, and the several a factors. Each construction necessitates modification of the formula in detail in order to accommodate it. The result is a long series of formulas but they are not given here

TABLE 1. VALUES OF HEAT CONDUCTIVITY (k) AND OF CONDUCTANCE (C)† OF COMMON BUILDING MATERIALS, OF AIR SPACES (a), OF SURFACES (f), AND OF HEAT INSULATION (k).

Units are B.t.u. per hour per degree temperature difference per square foot area and for 1 in. thickness except when otherwise noted.

Material	Thickness, Inches	k
Common Building Materials		
Blocks		
Cinder	8	0.62
	12	0.51
Concrete	8	1.00
	12	0.80
Bricks		
Common (clay)	1	5.0
Face (clay)	1	9.2
Glass	—	—
Cement mortar	1	12.0
Concrete	1	12.0
Gypsum fiber	1	1.66
Plaster (gypsum)	1	3.3
Plasterboard	3/8	3.73
	1/2	2.82
Plaster and wood lath	A	2.0
Roofing materials		
Built-up roofing	3/8	3.53
Composition roofing	A	6.5
Shingles		
Asbestos	A	6.0
Slate	1	10.37
Wood	A	1.28
Stone	1	12.0
Stucco	1	12.0
Tile or terrazzo	1	12.0
Tile, hollow clay	4	1.0
	6	0.64
	8	0.60
	12	0.40
	16	0.31
Tile, hollow gypsum	4	0.46
Wood lumber		
Maple	1	1.15
Yellow pine	1	0.80
Yellow pine lap siding	A	1.28
Surfaces and Air Spaces		f
Air spaces		1.1
Inside surfaces (f_i)		1.6
Outside surfaces (f_o)	at 15 m.p.h.	6.0

Material	Density, Lb. per Cu. Ft.	k‡
Heat Insulating Materials		
Asbestos wood	123	2.70
Balsa wood	20.0	0.58
Balsa wood	7.3	0.33
Balsam wool	2.2	0.27
Cabot's quilt	4	0.255
Celotex	13.2	0.34
Corkboard (pure)	14.0	0.34
	10.6	0.30
Dry zero	1.0	0.24
Eagle insulating wool	9.4	0.27
Fibrofelt	13.6	0.32
Glass wool	1.5	0.27
	0.85	0.25
Hairinsul (loose, 75% hair, 25% jute)	6.3	0.27
Hairinsul (loose, 50% hair, 50% jute)	6.1	0.26
Hairfelt	13.0	0.26
	11.0	0.26
Insulex or Pyrocell	30.0	1.0
	12.0	0.44
Insulite	16.9	0.34
Keystone hair	11.0	0.25
Linofelt	4.9	0.28
Lith	14.3	0.40
Maftex	16.1	0.34
Magnesia (rigid), 85% mag., 15% asb.	19.3	0.51
Masonite	19.8	0.33
Regranulated cork	8.1	0.31
Rock cork	14.5	0.33
Rock wool	10.0	0.27
Rock wool	21.0	0.30
Sawdust	—	1.04
Shavings	—	0.71
Temlok	15.0	0.33
Thermax	24.2	0.46
Thermofelt (felted, jute and asb. fibers)	10.0	0.37
Thermofelt (felted, hair and asb. fibers)	7.8	0.28
Thermofill (flaked gypsum)	34.0	0.23
	19.8	0.35
Torfoleum	10.2	0.29

"A" appearing in the column headed "Thickness, Inches" means "thickness as applied," not 1 in. thickness.

†Conductance (C) differs from conductivity (k) in that instead of being for 1 in. thickness it is for some other thickness. In column headed "Thickness, Inches" if thickness shown is 1 in. the corresponding value in next column is "k," if some thickness other than 1 in. is shown the corresponding value in the "k" column is really (C) and not (k) because the value is for the thickness specified and not for 1 in. thickness.

‡Values are for thickness of 1 in., reported by various laboratories but principally from tests at the Bureau of Standards. Tests at mean temperature of 90° mainly, but at 75° in a few cases.

as it is only necessary to have the type formula in order to follow fully the method used.

In the formula the letters *f* stand for the B.t.u. per hour transmitted between the air and the solid surface of the construction per square foot of the surface, per degree temperature difference between the surface and the air. The terms f_i and f_o simply distinguish between the inside surface and the outside surface, since the numerical values are different. The letter *x* stands for thickness of solid material, in inches; *k* for B.t.u. per hour per square foot transmitted through the solid homogeneous substances of the construction of a thickness of 1 in.; *a* stands for the heat transmitted across an air space within the construction.

As the letters are the denominators of fractions it is often more useful to simply handle the whole fraction instead of the letter only. When this is done we get:

$1/f_i$ = resistance to heat flow at inner surface
$1/f_o$ = resistance to heat flow at outer surface
1/a = resistance to heat flow across internal air spaces
1/k = resistivity to heat flow through solid materials.

The problem reduces itself to finding suitable values for either f, a, and k for the conditions met with or similar values of the fractions 1/f, 1/a and 1/k.

Reported Test Results

The tests on which our present values for these terms rest have been conducted over a long period of years by many investigators using various testing methods and apparatus. Naturally the reported results vary. Test procedures have developed gradually and so have the methods of reporting. Early tests often did not report full details and this has made it difficult or impossible to evaluate the early results relative to later ones. Also the resulting values have been so much published and republished that sources are confused and almost impossible to credit. Many recent testers have undoubtedly been credited in published works with establishing values which they have not originally found. No attempt is made here to note references to specific sources where values are given for it is felt that under present conditions any attempt to do so would merely result in additional inequities.

Several tabulators have prepared extensive tables showing the results of tests on a great variety of solid and gaseous materials in which the conditions surrounding the tests are often specified as to density,

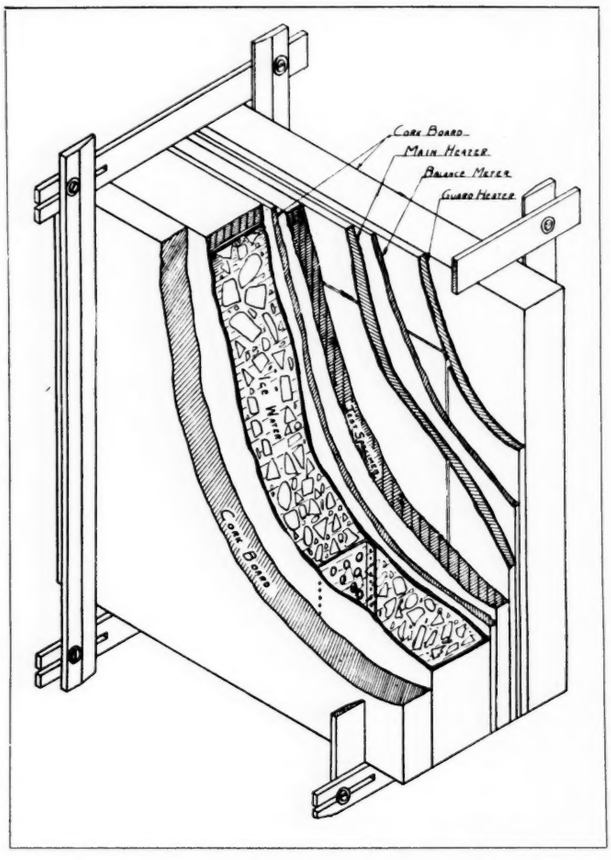


Fig. 3. A laboratory arrangement for finding the conductivity of a single material. Hot plate method.

temperature, moisture content, condition of surfaces tested and like details. Possession of such test data and details is valuable in forming conclusions and recommendations as to the correctness of the tests and as a guide to determine which of these many values are actually to be used in preparing practical tables of values of U. Faced with such tables with conflicting values it is a task requiring considerable judgment to select values suitable for practical use which will meet the conditions most generally met with and at the same time avoid unnecessary detail and undesirable complications. As various writers have approached the problem they have come to different conclusions as to what values are preferable. Table 1 gives values gleaned from numerous sources. It is believed that the values included represent a fair statement of the consensus of current opinion. Values are included for the materials most commonly encountered. The table does not list *all* the materials whose resistance to heat flow has been measured, being confined to those of most common occurrence in order to keep the table to usable size.

While these values have been selected from the tests reported it should be clearly understood that they are determined for steady flow only and under carefully controlled laboratory conditions. Most of them are doubtless correct within close limits under such conditions. However, materials put into walls and subjected to weather and use may change their characteristics greatly. They may settle, shrink, absorb moisture or dry out, warp, or oxidize. None of these facts are allowed for in any way in using the values to calculate U, for there is not enough information to permit this. The values of these factors therefore should not be considered as being permanently fixed. They represent strictly current ideas based on the information at hand.

Tables showing values of U for use in equation (1) and calculated from the values given in Table 1 will appear in an early issue.

Measuring Slow Air Movements

A NEW type of anemometer, especially designed for measuring slow air movements such as are present in refrigerator cars, has been developed by the Bureaus of Agricultural Engineering and of Plant Industry, U. S. Department of Agriculture. Operation of the instrument depends on the cooling of a heated wire when exposed to air currents.

So far the instrument has been used to measure only horizontal velocities, but engineers believe it can be used to measure velocities of any direction. Use of the anemometer will result, it is expected, in a better knowledge of the requirements for air circulation and of the conditions under which maximum circulation may be obtained in refrigerator cars.

The instrument is small enough to be placed under the floor rack of a car and may be read from the outside without disturbing conditions inside.

Previous to the development of the anemometer, observations of air velocities in cars were confined largely to smoke tests. Puffs of dense smoke were released at certain points in cars and observations were made of how long it took the smoke to travel to other points. The general direction of air movements could be followed and some idea of velocities of currents was obtained in this way. Difficulty of access to many positions in cars and diffusion of the smoke limited the usefulness of this method.

Also in making smoke tests, it is necessary for at least one observer to be in the car. In some cases, the presence of an observer is likely to set up independent convection currents or otherwise distort those being measured, engineers believe.—*Agricultural Engineering.*

Warm Air Furnace Championed

by reader who takes exception to statements in the article on Radiator Heat vs. the Warm Air Furnace in the November issue

IN last month's issue of HEATING & VENTILATING appeared an article[1] which set up a number of arguments for radiator heat as prepared by two advocates of that method, C. G. Newton and H. R. Coleman. Many, and perhaps most, of the statements made were more or less controversial, and few of them remain unchallenged in a defense of the warm air furnace which appear in a letter to the editor from W. W. Howe of Sausalito, Cal. Although the article last month was prepared by men quite frankly proponents of radiator heat, Mr. Howe claims a disinterested viewpoint, but says that he is "just foolish enough to get irritated when I read selling propaganda of the Newton-Coleman type." Mr. Howe's letter follows:

You have an interesting article in the November issue—"Radiator Heat vs. the Warm Air Furnace." The extracts from the booklet by Newton-Coleman were quite typical. There are a lot of fine people in the steam and hot water radiator business but I never met one yet that would intelligently or fairly discuss the relative merits of the radiator vs. warm air.

Everybody in the heating business knows that there have been many warm air furnace systems installed that were inadequate, badly designed and badly installed. By the same token, there have been plenty of steam and hot water systems of the same characteristics. But why bother with this? The fact is that the steam or hot water radiator system for the average residence is taking a beating at the hands of the fan-furnace air conditioning system and, if I am any prophet, will continue to do so. From the standpoint of sales arguments, the fan-furnace air conditioning system has five to one the best of it. The air system heats and cools, humidifies, filters and circulates while the radiator system heats only.

These are general statements. Let's get down to brass tacks, and take a small residence with a figured heat loss of say 72,000 B.t.u. per hr. This will call for a steam system of 300 sq. ft., and assuming just a simple one-pipe layout, will cost about $750. A first class fan-furnace system complete with filters and a humidity device of the constant water level type can be installed for about $450.

Here is an item of $300 right off the bat that the radiator salesman has to contend with, and he naturally has to show the prospective buyer something to make him willing to spend this much additional money.

The radiator salesman will probably start with comfort and attempt to prove that the radiator system guarantees perfect comfort to the user while the warm air plant is sure to do just the opposite. As far as heat is concerned, the facts are that either system produces very good indoor temperatures.

The fact that some additional moisture is required when artificial heat is used in a house is so well established that I will not bother to answer the Newton-Coleman paragraphs dealing with this phase. The warm air system is ideally adopted for supplying this additional moisture while the radiator system needs some additional humidifier or vaporizer which must be located at one point and which cannot do a really good job of distribution in this respect.

Filtered air is certainly to be preferred to untreated air. The warm air system filters the air before it reaches the registers. The radiator system makes no attempt to do this.

Summer cooling with mechanical refrigeration is added very simply to the air conditioning system. The expense of the refrigerating equipment is high and is therefore not generally used for the small residence. However, partial cooling is very easily accomplished by merely adding a duct to outdoors, through the foundation walls, and by shutting a damper in the winter return air duct, cool night air can be pumped through the house during the night hours with a very small expense for operating the fan and motor. Don't let any radiator salesman tell you that this is an impractical idea because it does work.

The radiator man will try to tell you that air from the warm air furnace bonnet is burnt out, devitalized or, as Newton-Coleman puts it "dry carbonized." A well designed fan furnace system will deliver air at the radiators at about 120°. The bonnet temperature is around 130°. The statement that such air is any more "dry carbonized" than the air delivered over a direct radiator is simply silly, but it is a fact that many radiator men advance it as a valid argument.

So having persuaded (?) his prospect that comfort is to be obtained with the radiator system without humidity-filtration, cooling, or circulation (which are all bad and useless because the radiator system is not designed to do these things), the radiator salesman next deals with the question of operating costs. According to his story the radiator plant will save the $300 difference in a year or two in smaller fuel bills.

The fact is that, supposing that both the steam system and the warm air system are well designed and installed, there is very little difference, if any, in the operating cost.

How about durability? The radiator salesman will tell you that the furnace system will probably fall into pieces within a few years while the steam system will last for the life of the house. Here we have to consider the kind of care that the systems will get at the hands of the owner. A steam boiler could be cracked and ruined in a few minutes of operation without water, the furnace can be burned out by excessive temperatures, but granting that intelligent care is used either system will last years.

When you get all through with the arguments, the radiator salesman simply cannot make a case unless he misrepresents.

A different line of attack by the radiator man is the attempt to sell an air conditioning system with the same features as the warm air system but the heat is supplied by a steam coil over or through which the air is blown by a fan, the steam being supplied by the usual steam boiler. When this line of selling talk is used, filtering, humidifying, circulation, cooling, etc., etc., is all part of the talk and very essential, but the point is stressed that the air, being handled over a steam coil, is far superior to the air handled over a furnace bonnet. That there is no practical difference in the quality of the air in the two cases is well known to all concerned except the prospective buyer who falls for this song and dance to the tune of several hundreds of dollars extra.

The steam coil air system, however, is well adapted for the large residence which has several wings and extends over a good deal of ground space because the steam coil units can be located in the various wings, fed from one boiler and the air ducts kept short.

If basement headroom is a factor, air ducts from the furnace can be made rectangular and kept close to the ceiling as the usual pitch for the gravity warm air system is not required when a fan is used to force the air through the system. Steam piping is, of course, still more compact but the advantage over the flat air ducts is slight.

The scoring table given by Newton-Coleman is certainly a masterpiece for a good laugh. Look it over:

	RADIATOR	FURNACE
Heating	1	0
Economy	1	0
Air motion	1	0
Humidity	1	0
Temperature control	1	0
Air cleaning	0	1
	5	1

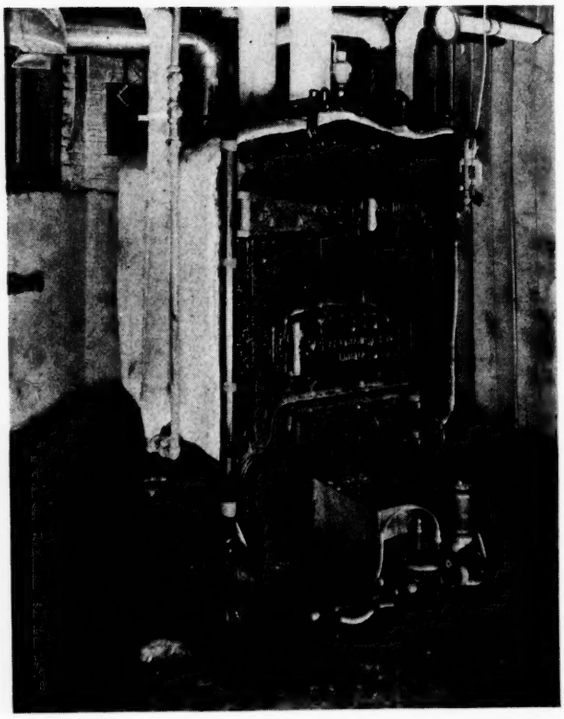
(Concluded on page 61)

[1] Radiator Heat vs. the Warm Air Furnace, HEATING & VENTILATING, November, 1935, page 33.

Engineering Gas Conversion Burner Installations

4—Checking the Final Job for Control Operation, Sizing, Flue Travel and Baffling

By ALFORD G. CANAR†



AFTER the installation of the burner has been made, the job must be put into proper operation so that satisfactory results will be obtained. This involves another phase of engineering requiring considerable care because a satisfactory job depends more on good engineering after the installation. A job may be perfectly engineered prior to installation and yet may operate very unsatisfactorily both from a heating and cost standpoint if the engineering after the installation is carelessly or poorly done. If the job was carelessly or poorly engineered prior to the installation it is subsequentiy necessary to compensate for or correct the pre-installation engineering as much as possible.

The engineering factors involved after the installation is made are as follows:

1. Checking the correctness of burner and control installation.
2. Checking correctness of flue size, installation of flue and position of draft diverter.
3. Checking design of boiler or furnace and flue travel.
4. Baffling.
5. Applying calculated approximate required gas rate to burner.
6. Adjusting the burner.
7. Checking the draft.
8. Making the heating test.
9. Checking for leaky steam valves on radiators and returns.
10. Checking proper functioning of thermostat and other controls.

The position of the burner should be carefully observed. The burner head should be centered in a round firepot, allowing an even clearance between all portions of the firepot wall and burner head. The burner head should be level and not tilted. The burner head should be about two inches above the grate line. In the case of furnaces where the cold air return boot extends appreciably above the grate line, it is not advisable to have the burner head higher than the two inches above the grate line, but rather to protect the portion of the return boot above the grate by a piece of refractory or insulating block cemented to the inside of the firepot, or by protecting with a black iron radiation shield between the firepot and the casing. If such a procedure is followed then slow circulation will be due to other features of the heating system.

In the case of a rectangular firepot there should be an equal clearance between burner head and firepot wall on both sides. In a case where the hot gases leave the firepot at the rear end the burner should be located closer to the front end of the firepot when the burner head is appreciably shorter than the firepot. If the gases leave the firepot at the front end the burner should be placed closer to the rear end. Where a vertical multiple-jet type of burner is used the burner head should cover practically the full width of the firepot. Where the horizontal type of multiple-jet or gun burner is used a checkerwork of firebrick should be built about 2 ft. from the face of the burner and high enough so that the flame can not leap over it. This checkerwork will radiate heat to the front end of the firepot, which, without the checkerwork, would not be permitted to absorb as much heat.

The burner orifices should be checked to determine whether the correct size orifice is being used for the probable gas consumption to be used.

The entire installation from burner head to meter should be checked to see that everything is there that should be there, and that everything is properly in stalled. This applies also to the controls. These

† Space Heating Division, The Peoples Gas Light and Coke Co., Chicago.

should be installed in the correct manner. A surface aquastat, which is the type generally used because it is cheaper and more easily installed, should be installed near the top of the vertical main riser above the boiler, or on the horizontal part of the main close to the elbow leading from the vertical riser. A low water cutoff should not be connected with an active return because the flow of the return water into the boiler can create a suction on it and thus cause it to function under a false water level. It is better to make a separate connection by tapping the boiler either in the waterleg or near the crownsheet. The water line on the low water cutoff should be at the normal water line of the particular boiler.

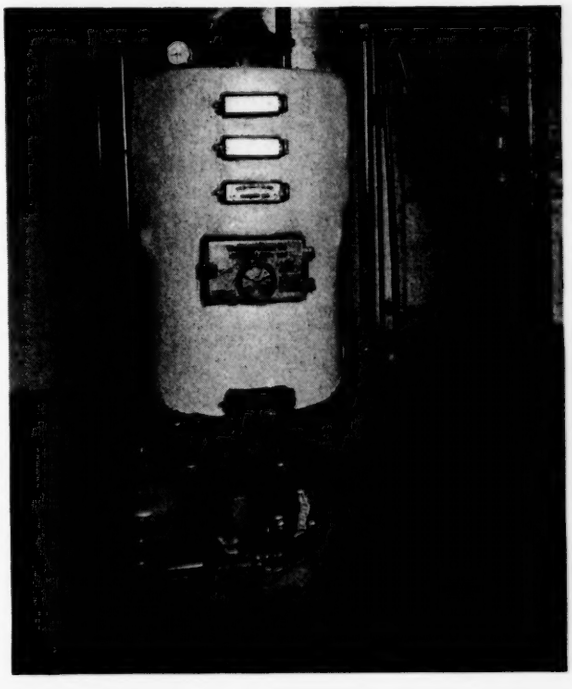
Flue Pipe

The flue pipe should be of a size depending on:

1. The probable gas consumption to be used on the burner.
2. The type of boiler or furnace, whether downdraft, sidedraft, or updraft.
3. Whether one or two 90° elbows are used, three or four, or whether no turns are encountered.

If there are two flue outlets from a furnace the flue pipe should invariably be connected to the lower outlet so that all the heating surfaces will be utilized. Connection may be made to both outlets, but the upper outlet should be blocked shut in some manner. Downdraft boilers and furnaces, if of any appreciable degree of downdraft design, should have the high point of the gas passages vented directly to the flue pipe by means of a ¾-in. pipe, so that if any gas leakage occurred when the chimney draft was at low ebb the raw gas would be vented.

A vertical or bell type draft diverter should be installed at least above the highest point of the upper flue passages in the appliance, and preferably about 18 to 24 in. higher. With downdraft types of appliances it is good policy to install the draft diverter as high as possible so as to achieve all possible advantage of flue action before the draft is broken by the draft diverter. Horizontal draft diverters should likewise always be installed higher than the high point of the flue passages in the appliance. Horizontal draft diverters should also be installed close to the chimney so that more heat is given off of the flue to the basement. Since conversion burner customers notice that their basements are not as warm as when they fired with solid fuel, give them all possible heat to the basement, especially from the flue pipe.



If, instead of a draft diverter, a draft control of the pendulum type is used, the flue pipe should be one commercial size (1 in.) smaller than the size called for on the flue sizing chart and the draft control should be at least 2 in. larger in diameter than the flue pipe. The draft control should also be installed between the chimney and the connection to the appliance, preferably closer to the chimney.

In the case of bricked-in breechings or other very substantial breechings which it is wise not to disturb, the size of the orifice should be equivalent in square inches to the gas consumption in cubic feet per hour divided by 13. This orifice should be close to the chimney and a draft control of the largest size that the dimensions of the breeching will accommodate, should be installed between the orifice and the appliance. If there is practically no breeching the orifice and draft control should be installed as explained in the preinstallation engineering sub-division on flue sizing of bricked-in breechings.

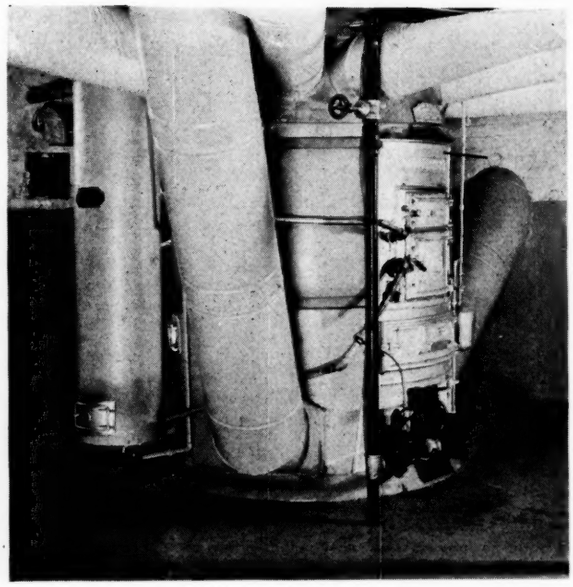
Design Characteristics of Boiler or Furnace

Earlier in this series it was pointed out that the smaller portion of the total heating surface is in the flue passages beyond the combustion chamber, and that with gas it was impossible to utilize the firepot heating surfaces to the extent possible when firing with solid fuel. Therefore, it becomes necessary that the indirect heating surfaces beyond the firepot absorb as much heat as possible from the gases; in other words, offset as much as possible the limitations of the direct heating surfaces in the firepot. Therefore, the upper flue passages should be carefully examined and studied to determine whether or not any of these heating surfaces are being bypassed, and if so, to remedy this condition by artificial means.

Any furnace which has a firebrick lining in the firepot should have this lining removed so that the best possible heat transfer can be obtained in the firepot. Experience with an appreciable number of these furnaces has shown that the operating cost was reduced an average of 12% by operating with the lining removed.

There is one exception to this rule of lining removal, and this is a furnace sometimes encountered in the Chicago area and marketed under two different names. It is the most extreme of downdraft types in that the gas passages descend to underneath the ashpit before they are vented to the flue pipe. The peculiarity of design which waives the removal of the lining is this: the firepot

is merely a basket inside the rectangular combustion chamber and on the reverse side of the firebrick lining there is a 4-in. passage on both sides and rear through which the gases pass downward to underneath the ashpit. An open flame burner without any baffles or radiants should be used so that the gases will descend to the top of combustion chamber before they descend on the outer side of the firebrick lining. Removal of the lining, which is contained within the latticed basket, permits the gases to take a shorter route to the downdraft passages, which is undesirable.



Various furnaces, especially those of the downdraft type, may have an indirect damper which when open permits the gases to exit to the flue outlet directly from the combustion chamber and thus bypass all or most of the indirect heating surfaces, which may amount to 45% of the total heating surface; but when the indirect damper is closed then all the gases are forced to travel the entire length of the flue passages before they exit to the flue. Flue temperatures of from 100° to 200° lower are attained when these indirect dampers are kept closed. They should be closed and securely fastened in the closed position. For the same reason, in the case of furnaces having double flue outlets the gases should leave the furnace only through the lower outlet so as not to bypass any of the indirect heating surfaces. Experience has shown that large reductions in flue temperature occurred when the appliance was vented through the lower flue outlet and operating costs were reduced over 10%.

Baffling

Coal boilers and furnaces are naturally designed to accommodate, in the flue passages beyond the firepot, the large volume of products of combustion, and in addition to permit adequate draft from the chimney to be transferred to the firepot so that sufficient air may be drawn in through the grates and bed of fuel to insure complete combustion when the equipment is fired at maximum capacity. Therefore, the flue passages are made comparatively large.

When such equipment is fired with gas a much smaller volume of gases of combustion is generated and the draft pressure required is only a small fraction of that necessary when firing with solid fuel. Hence such large flue passages are a detriment because they permit gases to channel through the center cores of the passages without scrubbing the heating surfaces. Furthermore, when firing with gas, it is not possible to utilize the direct heating surfaces in the firepot and combustion chamber to the extent possible when firing with solid fuel. Therefore, it becomes imperative that we must depend on the heating surfaces beyond the firepot to the maximum possible extent if we intend to obtain the best results. In other words, in the flue passages beyond the firepot it is essential that we utilize by transference to the heating medium the greatest number of heat units possible within the limitations of the given heating surface.

In other words, the purpose of baffling is to:

1. Change the path of the flue gas travel so that all the heating surfaces beyond the firepot are thoroughly scrubbed by the gases.
2. Evenly distribute the gases over all the heating surfaces.
3. Prevent channelling of the gases over any portion of the heating surfaces and thereby avoid contact with other portions.
4. Force the gases to take the longest possible travel through the flue passages, and thereby prevent short-cutting.
5. Prevent flue gases from avoiding contact with heating surfaces in straight flue passages of large size by sneaking through the center core of these passages.
6. Permit the longest possible time-contact period between the heating surfaces and the gases. This last phase is controlled to a great extent by the proper draft adjustment but can be enhanced by baffling.

Round Cast Iron Boilers

These boilers have a more or less staggered flue travel in the upper flue passages, but the design is often faulty, especially in that the flue openings in one section are entirely or partly superimposed over flue openings in the next lower section; or arranged in such a way that the gases have a comparatively short path from one section to the next above, that is, the staggering is less than the diameter could accommodate; or the flue openings on one section may be spread so far apart that the gases will tend to channel across a portion of the heating surfaces and thereby avoid to a great extent the surfaces between these channels.

These faults are not always attributable to the designer of the boiler. It has often been found that the combination of upper sections encountered is not what the designer or manufacturer intended. The steamfitter who installed the boiler did not arrange the upper sections in the proper sequence. This feature has been found to a greater extent among the old center nipple types of design, where the upper sections interconnect by means of a center nipple. Even though the steam-

fitter used the correct combination of sections, because of the center nipple connection, it often happened that he did not place the sections in such a lateral position that the maximum staggering of flue openings was obtained.

The boilers which need baffling most are the four-section variety, which have either a crownsheet integral with the firepot section and a dome, or else no integral crownsheet, one intermediate section and a dome. The corresponding five-section boilers also need it but to a lesser extent and six-section boilers still less, depending, of course, on the design of the flue travel. The benefits of baffling become less, other things being equal, as the number of upper sections increases. Four-section boilers can be improved by proper baffling to an extent that operating costs can be reduced an average of 15%. With five-section boilers the improvement is less, and with six-section boilers still less, because as the upper sections increase in number the arrangement of the flue travel improves because of better staggering of flue openings. However, as pointed out above when referring to center nipple types of boilers, a five- or six-section boiler may need baffling as badly as an ordinary four-section boiler. It is all a question of the design of the flue travel.

Baffling can readily be done with sheet iron or cast iron forms so designed that when disposed in the proper positions on or between the upper sections the purposes of baffling enumerated above are accomplished.

Sectional Cast Iron Boilers

Square or rectangular sectional boilers usually have comparatively large flue passages and since these passages are usually straight, some of the gases can channel through the center cores of the passages without scrubbing the heating surfaces. If these center cores of the straight flue passages are blocked off and the flue passages narrowed down to 1½ to 2 in. clearance on all four sides of the blocking then the gases are forced to have a far more intimate contact with the heating surfaces. This can readily be done by blocking off the center cores of the flue passages with brick. These bricks should be supported on a sheet metal table support so that the bricks do not cover any heating surface. The height of the table support should be at least 1½ in. and the clearance between the brick and the heating surfaces should be fairly equal on both sides, top and bottom. Maximum effectiveness of baffling is obtained only when the baffling extends for the full length of all the passages. It is advisable to baffle all flue passages which have dimensions in height or width in excess of 4 in.

Some sectional boilers are so designed that they have narrow openings between all the sections where the hot gases pass through from the firepot to the upper flue pasages. The gases coming up through the front openings have a shorter path to the flue outlet than those coming through the openings farther back. This condition should be corrected so that a longer flue travel is obtained. This can be done by covering the front openings and forcing the gases to all come through a few of the rear openings instead, allowing an opening area of at least that of the flue pipe diameter.

The flue passages of sectional boilers should be carefully checked to see that sections are properly cemented together where they should be, else shortcutting of gases will occur.

Appreciable improvements can be made by baffling all sectional boilers having flue passages wider or deeper than 4 in., or where shortcutting of gases occurs.

Steel Boilers

The most common type of steel boiler is of the horizontal firetube type. Some of them, especially the firebox type, have a horizontal baffle wall built between the center of the drum and the bricksetting under which the gases pass in making one pass and over which they pass in making another pass. These baffle walls usually extend forward to the rear end of the firebox. Such baffle walls have often been found partially or completely broken down, which permitted shortcutting of gases. These should be repaired to obtain full length of flue travel. Baffling of tubes by means of spirals causes a better scrubbing action and a greater heat absorption, but to be really effective should be done in all the tubes for their entire length. Because of the expense it is not recommended in tubes under 3-in. diameter because steel boilers usually have a very large amount of heating surface and the greater portion of it is beyond the firepot especially in the firebox type. Baffling tubes as small as 2 in. in diameter is advisable in those steel boilers where the gases make one pass through all the tubes and then exit to the flue.

In the next and concluding installment the author discusses the matter of checking the applied gas rate.

H & V Congress Scheduled for France

THE Sixth Congress of Heating and Ventilating will be held in Paris in the amphitheater of the National Conservatory of Arts and Trades in May or June, 1937. The date previously reported has been advanced one year so that this Congress can benefit by the International Exposition of 1937. To make the discussions of the greatest usefulness, only subjects not previously dealt with and only those whose interest is general have been selected for discussion by the Congress.

The following main topics are announced: Flues, boilers and boiler rooms, hot water heating and hot water supply systems, air conditioning, transmission of heat, and automatic regulation. Among the phases of air conditioning to be discussed are its application in the colonies, its use in shelters against bombardments, and its adoption in vehicles.

EDITORIALS

A Construction Census

There is to be another Construction Census in 1936. Before long every contractor is to be asked to fill out a Census Bureau form giving information on his 1935 business. From the returns the Bureau expects to be able to publish a picture of how the construction industry fared during the year. Supplying information to Washington bureaus is getting to be a major industry. In spite of the effort required on the part of individual contractors, collection of such information periodically is becoming increasingly essential—not to contractors themselves perhaps so much as to those responsible for production and sales planning, but essential nevertheless. No agency except the Census Bureau is equipped to do a thorough job of this kind. Cooperation on the part of contractors is necessary to make it a success. It ought to be cheerfully and promptly given. Publication of the results of the 1929 census of construction was delayed but it is hoped that they can be made available more promptly this time.

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Standards and Rules for Air Conditioning

For some months since problems connected with suitable standards for air conditioning were recognized as being acute, various groups have been at work. As the committee method of procedure was used and as there were so many viewpoints to be adjusted, work was necessarily slow. Now, however, the findings of three important groups have appeared in the form of printed rules.

A Chicago committee has drawn up a report covering the essentials for arriving at the calculated load, and for ensuring suitable installation to conform with Chicago practice. A committee of the Air Conditioning Manufacturers' Association has produced a set of rules to govern testing and rating of air conditioning equipment and a set of clarifying definitions of such equipment. Both these reports bear the endorsement of important organized groups within the industry.

The third set of standards is in the form of a proposal to amend certain sections of the Building Ordinances in New York City. It has to do with safety considerations and specifies limitations surrounding the use of refrigerants in air conditioning as to amounts and kinds of refrigerants, location of compressors and piping, and specifies the setting of safety valves and gives many rules covering installation and operation. It still has to run the gauntlet of public hearings and enactment. As it is drawn up as a result of prolonged discussions there is reason to believe that it will find its way into the ordinances without material change.

In this issue are the principal points of the proposed New York ordinance changes, a summary of the report of the Air Conditioning Manufacturers' Association committee, and the rules of the Chicago committee in full. They are presented with no more than minor clarifying comment and without attempt at analysis or explanation of the meaning or effects of the provisions. Everyone concerned with air conditioning should read them to note what they contain and to see the direction which these standardizing efforts are taking.

Several points are evident at once and deserve comment. Appearance of these rules by no means solves the problem of standardizing air conditioning practice. The fact that these rules are in existence does show gratifying progress along the several lines of attack. It is more than likely that at least the rules of the Chicago committee will be used as the basis of similar moves elsewhere. The whole problem of adequate enforcement is till before us, and there is still much to be done in coordination before really sound practices can be expected to grow up under the standards. The problem is necessarily a continuing one, but we can be glad that it is being attacked.

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Federal Housing Administration Should Be Extended

On April first next the law under which FHA exists will expire. Unless something is done in the meantime FHA will expire with it. With its demise the only public agency intended "to encourage improvement in housing standards and conditions, to provide a system of mutual mortgage insurance" on a national scale would go out of existence. We believe that by far the great majority of those engaged in heating, ventilating and air conditioning work do not want this to happen.

In the year and a half since FHA came into existence it has compiled a notable record. It may not have done all that was expected of it, it may have missed opportunities, it may be bureaucratic and inefficient. We do not know. Perhaps such an agency is an excursion into fields which private insurance might cover. We do not know.

To us such considerations seem rather unimportant because we do know that FHA has accomplished at least two objectives. For one thing, it brought both immediate business and hope to many people in this industry just when they were at a loss as to what to do. For another, it brought about notable emphasis on a logical method of financing both modernization work and new construction.

If the whole movement had done nothing more than what has already been accomplished toward establishing the principle of but one loan on the unpaid balance of a time obligation with systematic repayment, it would have done enough to justify itself. As a matter of fact it has accomplished a good deal more. It would seem that extension of the Administration should follow as a matter of course.

It is too early to judge this now. The opposition is not out in the open. Neither is it clear as yet how FHA will fit into proposals which it is rumored will be brought forward soon to promote a greatly expanded construction of new housing. That there will be opposition to extension is almost certain. How effective it may be cannot be predicted. Neither is there anything specific now around which to rally support except FHA itself in its present form and with its current program.

We believe FHA is worthy of extension and that regardless of added plans its principal activities must not be permitted to go into the discard. It may be that early in the coming year it will be necessary for all of us to lend support. When the call comes to get behind a specific bill let there be no withholding of needed support.

THE DEGREE-DAY

TABLE 1. NORMAL YEARLY DEGREE-DAYS FOR 94 CITIES.

City	Normal Yearly Degree-Day
Alabama	
Birmingham	2352
Mobile	1471
Montgomery	1884
Arkansas	
Fort Smith	3213
Little Rock	2811
California	
Los Angeles	1504
Sacramento	3127
San Francisco	3264
Colorado	
Denver	5874
Connecticut	
New Haven	5895
District of Columbia	
Washington	4626
Florida	
Jacksonville	890
Pensacola	1249
Georgia	
Atlanta	2890
Macon	2201
Savannah	1490
Illinois	
Chicago	6290
Rockford	6847
Urbana	5805
Indiana	
Ft. Wayne	5934
Indianapolis	5298
Terre Haute	4872
Iowa	
Davenport	6289
Des Moines	6384
Sioux City	6898
Kansas	
Topeka	5307
Wichita	4673
Kentucky	
Louisville	4180
Louisiana	
Baton Rouge	1349
New Orleans	1024
Maryland	
Baltimore	4533
Massachusetts	
Amherst	6894
Boston	6045
Fitchburg	6632
Nantucket	5957
Michigan	
Detroit	6490
Saginaw	7063
St. Joseph	6203
Minnesota	
Minneapolis	7850
Rochester	7986
Missouri	
Kansas City	4852
St. Louis	4585
Nebraska	
Omaha	6131
New Hampshire	
Concord	7353
New Jersey	
Atlantic City	5176
Dover	6270
Jersey City	5193
Newark	5383
Paterson	5365
Trenton	4933
New Mexico	
Albuquerque	4298
New York	
Albany	6580
Binghamton	6808
Buffalo	6822
Elmira	6412
New York	5347
Syracuse	6893
North Carolina	
Greensboro	3527
North Dakota	
Grafton	10278
Ohio	
Cincinnati	4703
Cleveland	6155
Dayton	5264
Oklahoma	
Oklahoma City	3613
Oregon	
Portland	4469
Pennsylvania	
Erie	5866
Harrisburg	5375
Philadelphia	4855
Pittsburgh	5235
Reading	5389
Scranton	6129
Uniontown	5278
Williamsport	5450
Rhode Island	
Providence	6014
South Carolina	
Charleston	1769
Columbia	2364
South Dakota	
Aberdeen	8279
Tennessee	
Chattanooga	3118
Nashville	3578
Texas	
Dallas	2287
Ft. Worth	2148
Houston	1157
San Antonio	1202
Utah	
Salt Lake City	5555
Vermont	
Burlington	7620
Virginia	
Lynchburg	4019
Richmond	3725
Washington	
Seattle	4966
Spokane	6355
Tacoma	5181
Walla Walla	4809
West Virginia	
Wheeling	5249
Wisconsin	
Madison	7395
Milwaukee	7245
Sheboygan	7388

The Degree-Day Explained

THE degree-day as an estimating unit for fuel consumption in connection with the heating of buildings has been in wide use since 1925, and its popularity is still growing. Since 1927 HEATING & VENTILATING has published monthly figures on the number of degree-days for different cities, and in 1930 published the HEATING & VENTILATING *Degree-Day Handbook* which gave normal degree-day figures for 1000 cities by months. These activities undoubtedly contributed to the ever-increasing use of the degree-day unit.

Table 1 lists the normal yearly degree-days for 94 of the more important cities. The figures are based on data gathered over a period of from 20 to 50 years ending about 1922.

A brief outline of the uses of the degree-day unit, together with instructions as to how it can be used, follows:

The degree-day is based on the fact that the amount of fuel used in the heating of buildings is proportional to the number of degrees the outside temperature falls below (about) 65°. This base temperature was found to be 65° for residences and for other buildings as follows: Office buildings, 66.2°; stores, 64.0°; apartments, 68.8°; service buildings, 61.2°.

However, all of these are near enough to 65° so that that figure can be used for all practical purposes.

The number of degree-days per day is the difference between 65° and the mean outside temperature when the outside temperature is below 65°. (If the mean outside temperature is above 65°, there are no degree-days.) On a day, for example, when the mean outside temperature is 60° there are five degree-days that day. Totalling these for the month gives the number of degree-days for that month, and this is a measure of the amount of fuel which is used for the heating of buildings in a given locality.

Obviously the number of degree-days varies from city to city and in each city

TABLE 2.

	Philadelphia		St. Louis	
	"Average" Degree-Days	1934-35 Degree-Days	"Average" Degree-Days	1934-35 Degree-Days
September	—	8	—	60
October	242	280	205	114
November	588	433	597	443
December	905	902	936	983
January	1,001	1,052	1,060	985
February	893	893	854	739
March	756	584	657	436
April	402	412	276	397
May	68	182	—	162
June	—	13	—	14
Total	4,855	4,759	4,585	4,303

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THE DEGREE-DAY

TABLE 3.

	Lb. of Coal per Degree-Day per Sq. In.	Cu. Ft. of Gas per Degree-Day per Sq. In.	Gal. Oil per Degree-Day per Sq. In.
First floor leader.....	0.0037	0.044	0.000318
Second floor leader...	0.0056	0.067	0.000477
Third floor leader....	0.0067	0.080	0.000571

from year to year. The average or normal number of degree-days (as given in Heating & Ventilating's *Degree-Day Handbook*) is the average number of degree-days for the months of the heating season based on weather bureau records for a long number of years.[1] A comparison of these normal degree-days for a given month for a given city with current monthly figures for that city shows how much fuel should be used currently relative to an average month or year.

Table 2 gives the number of degree-days for an average year in two different cities and also for the heating season 1934 and 1935.

Referring to this table we see that a Philadelphia building should have used 4759 ÷ 4855 or 98% as much fuel in the season 1934-35 as during an average year. Similarly, a St. Louis building during that season should have used 4303 ÷ 4585 or 94% as much fuel as in a normal year.

In determining the amount of fuel which should be used for a given building per degree-day the following figures can be used with *corrections as outlined later:*

0.0006857 gal. of oil per sq. ft. of steam radiator per degree-day; 0.008 lb. of coal per sq. ft. per degree-day; and 0.096 cu. ft. of gas per sq. ft. per degree-day. These figures apply to a steam system designed to maintain 70° in 0° weather, 100% efficiency of the plant, and for heating values of the fuel as follows: 140,000 B.t.u. per gal. for oil; 12,000 B.t.u. per lb. for coal, and 1,000 B.t.u. per cu. ft. for gas.

These figures must be corrected if the system is other than steam by multiplying by ⅝ for hot water. For warm air the uncorrected unit figures are as shown in Table 3.

An additional correction must be made for the heating value of the fuel used. The figures which are given are based on the heat content of 140,000 B.t.u. per gal. of oil, 12.000 B.t.u. per lb. of coal, and 1,000 B.t.u. per cu. ft. for gas. For other heating values multiply these by the quantity (heat value given above) ÷ (heat value of fuel actually used).

Still another correction must be made for the design temperature for which the radiators were designed. The unit figures given are for systems designed to maintain 70° with minimum outside temperature of 0°. If the system was designed for temperatures other than 0° to 70°, multiply by the factor determined as follows: (70°) ÷ (70° — outside temperature designed for).

For example, if this system was designed to maintain 70° in + 10° weather, the factor would be as follows: (70) ÷ (70–10) = 7/6.

This correction often causes confusion inasmuch as it apparently seems that for southern cities with relatively high minimum temperatures this fraction is more than 1, giving the impression that more fuel is used in a southern city than in a northern one. Note, however, that this is a *unit* figure; that is, the fuel consumption per square foot of radiator per degree-day. A southern building where a minimum outside temperature would be 30° would have only (70–30) ÷ (70) or 4/7 of the amount of radiator surface installed in a given building as would be required in exactly the same building in a northern city where the minimum temperature is 0°. Consequently, for the total building this fraction and the one relating to the minimum design temperature would cancel each other and the amount of fuel used in the whole building in each location would be the same *per degree-day.* The southern city having fewer degree-days in a season obviously, then, would use less fuel for the season.

An additional correction must be made for the efficiency of the system. The factors as given are based on 100% fuel burning efficiency which is obviously never obtained. Corrections can be made for this according to the judgment of the user as to the efficiencies of different types of systems and fuels. To correct, divide the unit figure by the efficiency.

The question is sometimes raised as to whether the amount of radiator surface used in the building in connection with the degree-day should be the net installed surface or the total amount, including piping. The answer is that the quantity used should be the amount determined by the heat loss calculations.

EXAMPLE OF USE OF DEGREE-DAY: What will be the coal consumption in the city of Philadelphia for a stoker operated heating plant containing 400 sq. ft. of hot water radiation, designed to maintain 70° in weather 10° above zero, the coal having a heating value of 10,000 B.t.u. per lb. and an efficiency of the system being assumed at 55%?

We have noted that 0.008 lb. of coal is required under certain conditions. In our example, a water system is installed instead of steam, so that we multiply our 0.008 by ⅝ to obtain 0.005. Our system was designed for + 10°, so that we multiply our 0.005 by 7/6 to obtain 0.00584. Assume a 55% operating efficiency, divide 0.00584 by 0.55 and we get 0.0106.

The heat value of the fuel in our example being 10,000 B.t.u. per lb. instead of 12,000, we multiply the 0.0106 by 12,000/10,000 to obtain 0.0127, which is the pounds of coal required per degree-day per square foot of radiator. Since our example gives 400 sq. ft. of radiator, we multiply 0.0127 by 400 and obtain 5.08 lb. of coal for this system per degree-day. Since Philadelphia has 4,855 degree-days per normal season, the fuel consumption for a year will be 4,855 multiplied by 5.08, or 24,663 lb., or 12.3 tons. Table 4 shows the steps used in solving.

TABLE 4.

Type of System	Design Temperature °F.	Efficiency, %	Heating Value B.T.U. per Lb.	Lb. Coal per Sq. Ft. Radiator per Degree-Day
Steam ...	0-70	100	12,000	0.008
Water ...	0-70	100	12,000	0.005
Water ...	10-70	100	12,000	0.00584
Water ...	10-70	55	12,000	0.0106
Water ...	10-70	55	10,000	0.0127

[1]Obviously, the exact figure in the average for any city depends on the particular years which are averaged. Figures used by Heating & Ventilating as averaged for a given city are the averages for a period ending approximately 1922 and beginning back as far as 50 years for some cities, depending on the data available for that city. Some organizations independently calculating the averages use records for more recent years which give slightly different figures but which do not differ from others by more than 1%. Since the degree-day cannot be used within a limit of accuracy of 1%, it makes but very slight difference which averages are used.

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ABSTRACTS of Current Papers, Books and Pamphlets

Diesel Engines

A new method of heating which is daily receiving more attention employs the waste heat from diesel engines. It is possible in certain industries to recover enough energy from the cooling water and exhaust gases to heat the building housing the entire plant. The heat may also be used for warming the water used in many processes. For these reasons, if for no other, the heating engineer should be familiar with the operations of the diesel engine and with the possibilities of recovering the waste heat.

The author of this volume is a man who has had over twenty years experience as a designer and engineer in the diesel engine field. He has included in this volume chapters on cooling systems and waste heat utilization.

The book is essentially a practical treatment of diesel engines, showing what they are, what they do, how to select them for specific purposes. It gives a comprehensive picture of the various types of engines, classifying them according to general service applications. The principles of operation are discussed as well as the installation, operation, maintenance, and performance.

[*"Diesel Engines," by J. W. Anderson, published by the McGraw-Hill Book Co., Inc., New York. Cloth binding; 6 x 9 in.; 491 pages. Price $5.*]

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Corrosion — Causes and Prevention

The second edition of Speller's book on corrosion brings up to date this standard and well known work. Since the first edition was presented some 3,000 articles on corrosion of metals have been published so that now more and better experimental data are available both on the influence of the various factors and the means of prevention. Practically all of the more important developments of the last few years have been reviewed in this edition.

The type of treatment and form of the book remain much the same, although in some cases the older sections have been condensed or omitted where better data are now available. It was necessary to do this in order to keep the size of the volume within reasonable bounds.

While practically all of the material in this volume should prove of value to the heating and air conditioning engineer, some of the chapters should be on the "must" reading list of every engineer. Among these are the chapters on the nature and mechanism of corrosion, the prevention of corrosion in the atmosphere, the prevention of corrosion underwater, and the prevention of corrosion in heating systems.

The section on heating systems takes up first the controlling factors of corrosion such as the composition of the metal and the composition of the feed water. Feed water treatment for steam and hot water systems is then discussed. Since the various types of heating systems offer different problems they are taken up separately. There are sections on hot water heating systems, low pressure steam heating systems, district heating systems and the consumer's heating systems on district heating lines.

Other chapters of interest are on the influence of methods of manufacture and treatment, influence of factors external to the metal, prevention of corrosion in closed water systems by removal of dissolved gases, and the prevention of corrosion underground. There is also a selected bibliography of some 500 references on the corrosion of ferrous metals.

[*"Corrosion—Causes and Prevention—Second Edition," by Frank N. Speller, published by McGraw-Hill Book Co., Inc., New York. Cloth binding; 6 x 9 in.; 694 pages. Price $7.*]

BOILER WATER TROUBLES. A critical review of what is now established in boiler water chemistry. Booklet sets up briefly in one reference a practical background of established fact for use of boiler operators in any place. Also certain peculiar and specific problems encountered in western Oregon are outlined. [*"Boiler Water Troubles and Treatments with Special Reference to Problems in Western Oregon," by R. E. Summers. Bulletin Series, No. 5 published by the Engineering Experiment Station of the Oregon State Agricultural College, Corvallis, Ore. Paper cover; 6 x 9 in.; 52 pages. Price 25 cents.*]

COMPARISON OF ANTHRACITE AND BYPRODUCT COKE. This is the second report of the technical subcommittee of the Anthracite Institute Merchandising Committee. The comparison of the characteristics of anthracite and byproduct coke is based on the results of anthracite analyses by the Bureau of Mines and coke analyses by a firm of analytic chemists. All coke samples were purchased in the open market. Thirty-seven points of comparison are listed. [*"Anthracite and Byproduct Coke," report No. 2, Published by the Anthracite Institute, Primos, Pa. Paper bound; 6 x 9 in.; 25 pages, price 25 cents.*]

FIBER INSULATING BOARD. This is the second edition of the Department of Commerce commercial standard on fiber insulating board. The standard is a minimum specification for two classes of fiber insulating board designated as "Insulating building board" and "Roof insulating board." It established definite criteria of insulating value and other physical requirements. [*"Fiber Insulating Board"—second edition. Commercial Standard CS42-35. Paper cover; 6 x 9 in.; 11 pages. For sale by the Superintendent of Documents, Washington, D. C. Price 5 cents.*]

HANDBOOK OF CHEMISTRY AND PHYSICS. The twentieth edition of this well known handbook which contains a wide variety of information of value to the busy scientist and engineer. It is divided into five sections, Mathematical Tables; Properties and Physical Constants; General Chemical Tables; Heat, Hygrometry, Sound, Electricity and Light, and Quantities and Units, Miscellaneous Tables. [*"Handbook of Chemistry and Physics"—Twentieth Edition, edited by C. D. Hodgman and published by the Chemical Rubber Publishing Co., Cleveland, Ohio. Flexible binding; 4 1/2 x 6 1/2 in.; 1966 pages. Price $6.*]

HUMIDITY CONTROL WITH CHEMICALS. A discussion of the use of both liquid and solid chemical salts for the maintenance of a constant humidity in show cases and small rooms. Includes a table showing the relative humidities obtainable with the following salt hydrates: magnesium sulphate, zinc sulphate, sodium-hydrogen phosphate and nickel sulphate. [*"Preservation by Control of Humidity" by L. W. Burridge. Journal of the Institution of Heating and Ventilating Engineers, London, May, 1935, page 132.*]

MINE VENTILATION. A study of the resistance of mine timbers to flow of ventilation air and a comparison of the effectiveness and economy of various types of supports. The study yields indications as to the optimum choice of timbering, to suit a given condition. [*"The Resistance of Mine Timbers to the Flow of Air As Determined by Models," by Cloyde M. Smith. Bulletin No. 279 of the Engineering Experiment Station, University of Illinois, Urbana, Ill. Heavy paper binding; 6 x 9 in.; 64 pages. Price 65 cents.*]

THE MUNICIPAL SMOKE PROBLEM. A booklet designed to give students of high and preparatory schools a knowledge of fuels and their use. Contains information and advice on the selection of fuel and the best method of burning it to secure efficiency and practical smokelessness. [*"The Municipal Smoke Problem," by H. B. Meller and L. B. Sisson. Paper binding; 5 x 7 in.; 20 pages. Copies may be obtained gratis from the Mellon Institute of Industrial Research, Pittsburgh, Pa.*]

NEWS OF THE MONTH

Milener Succeeds Berghorn at A. G. A. Headquarters

NEW YORK—Eugene D. Milener has been appointed secretary of the industrial gas section of the American Gas Association, succeeding C. W. Berghorn, who has resigned to become executive secretary of the Association of Gas Appliance and Equipment Manufacturers.

Mr. Milener has been a member of the AGA's headquarters staff for seven years. Previously he had held various positions with Consolidated Gas Electric Light & Power Company of Baltimore. He was one of the small group of men who pioneered and first introduced central house heating with manufactured gas and has seen it grow to be one of the most important activities of gas companies.

In 1915-16 he devised and first applied what has since become known as the degree-day method of calculating and comparing the gas requirements for heating different types of buildings under varying temperature conditions. This method is now universally used throughout the gas industry and by the heating, ventilating, and air conditioning industries. Some years later Mr. Milener proposed and first used the analysis of the four winter and four summer factors that compose year 'round air conditioning, which analysis is now a generally accepted method of describing comfort air conditioning.

When the AGA testing laboratory was instituted Mr. Milener organized the central house heating approval requirements committee and was chairman of that body during the period when the approval requirements code was being compiled. As a member of headquarters staff Mr. Milener has directed the Association's research activities in industrial gas utilization and has recently undertaken similar work in the domestic field. He will continue as secretary of the committee on industrial gas research and the committee on domestic gas appliance research.

Coal Tests Under Way at Battelle

CHICAGO—On the recommendation of Howard N. Eavenson, chairman of the research program committee, a committee of three combustion engineers has been named to supervise the work in progress at Battelle Memorial Institute on behalf of Bituminous Coal Research, Inc. The committee as now set up includes J. E. Tobey, fuel engineer, Appalachian Coals, Inc.; J. B. Morrow, preparation manager, Pittsburgh Coal Company, and John Fielding, Jr., Hanna Coal Company. It will be the function of this committee to maintain close contact with the work under way at Battelle and recommend any changes in procedure which may appear advisable. The committee also will analyze the results of the various tests made and assist in the preparation of the final report on each project.

Comprehensive plans for thorough tests of the comparative values in costs of heating with coal, gas and oil in residences by Bituminous Coal Research, Inc., are reported to be ready to be put into effect. Ralph Sherman, fuel engineer at Battelle, has arranged for tests in frame and brick houses, for hot water, steam, and warm air heating, and for testing under these different conditions low volatile coal, high volatile coal, both hand and stoker fired, coke, gas and oil, in about 15 buildings. The actual tests will take at least 24 weeks, or practically the entire heating season.

A. C. Standards Proposed for Buffalo

BUFFALO, N. Y.—L. A. Harding, consulting engineer, discussed standards for summer air conditioning and talked on the Chicago code for air conditioning at the regular meeting of the Western New York Chapter ASHVE, November 18. Mr. Harding commented on the various phases and ramifications of the Chicago code, especially those parts which, when applied to Buffalo, should be slightly changed. He said that during this past summer Buffalo had only two days which reached a maximum of 87° dry bulb, and 76° wet bulb, and suggested these as the design load condition for Buffalo.

In the discussion, A. A. Criqui commented on his interpretation of the Chicago code concerning 2° variation between the temperature of the incoming air stream and the temperature of the air in an occupied zone. He suggested that the height of the occupied zone should be mentioned.

B. C. Candee reported that condenser water temperature on tests conducted on the hottest days this summer was 73° in Buffalo, while L. P. Saunders, reported that this temperature in Lockport was as high as 85°.

Following an informal discussion of a local air conditioning code it was voted to authorize the chapter's president, W. E. Voisinet to appoint a committee to formulate such a code. This committee was appointed and includes M. C. Beman, A. A. Criqui, C. J. Hamlin, Jr., L. A. Harding, J. J. Landers, D. J. Mahoney, W. E. Voisinet, and Messrs. Friedenberger, Kaiser, Meyer, and Scanlon.

A.C. Comfort Standards Discussed

TORONTO, ONT.—The attendance at the regular monthly meeting of the Ontario Chapter, ASHVE, held November 4, was unusually large and much interest was shown in the main address "Comfort Standards for Summer Air Conditioning." This address, which was delivered by F. C. Houghten, director of the research laboratory in Pittsburgh, dealt with the series of interesting experiments carried out at the laboratory during the past summer in an effort to obtain further data on the air conditioning standards necessary to insure summer comfort.

Mr. Houghten, who was briefly introduced by E. Holt Gurney, advised the Toronto chapter to found a laboratory, a project which would meet with much success owing to the fact that the meetings of the local chapter were the best attended of any outside New York, Philadelphia, and Chicago.

During the meeting, the following nominations were announced: E. Holt Gurney, nominated second vice-president of the society; Cyril Tasker, nominated for the research council of the society.

Heating Coulee Dam Dormitories

GRAND COULEE DAM, WASH.—Last word in automatic heating facilities has been provided in the vast new dormitories for single men of the reclamation bureau staff, who are reclaiming a vast area by modern engineering skill. They were ready for occupancy in November.

In the new north dormitory of the series of bachelor halls is the central heating plant that will supply abundant hot water and steam to the dormitories as well as the administration building, which is located across the street. Three large boilers have been installed.

Complete insulation covers every pipe so that circulating hot water returns to the main tank with a loss of only five degrees of heat in completing its circuits, while hosts of dials, gauges, thermostats, and thermometers throughout the heating room provide for minute adjustments and scientific conservation of the heat.

Engle Has New Post

BOSTON—M. D. Engle, first vice-president, NDHA, has been appointed superintendent of the station engineering department, Boston Edison Company, succeeding George E. Seabury, who has retired. I. E. Moultrop, chief engineer of the Edison's station engineering department, has also retired from his Edison post.

Gift Home Promotes A.C.

DENVER—Through cooperation with a score of leading Denver business concerns who are sponsoring a $20,000 gift "Cinderella House," the Public Service Company of Colorado is making the populace of this section of the Rocky Mountain west "air-condition-minded." A subject on which the average citizen in this altitudinous part of the country knows little, because the chief problem here is lack of moisture in the air as contrary to the problem elsewhere, thousands of persons daily are familiarizing themselves with it through large displays placed in four of the city's leading downtown theaters. On exhibit in their lobbies are large air conditioning machines and gas furnaces identical with those which are to be installed in the "Cinderella House" which is to be given away to the lucky holder of the winning ticket in a drawing in one of the eight theaters cooperating in the contest.

The house, now under construction in one of the city's most exclusive residential sections, will be a two-story brick structure. It will be equipped with a gas furnace air conditioner. An electric clock type thermostat, blower starter, and high limit control and humidistat will be furnished and installed completely by the Public Service Company.

The air conditioning system is of the washed air type using a spraywheel that insures the air being washed through approximately sixty sheets of water, spun from the spraywheel. Departing from the old standards, registers, which are of the forced air type, will be placed 6 ft. 6 in. up from the floor, thus eliminating drafts in the summer and giving added convenience in the placing of furniture and added comfort to occupants of the room. Return air registers are to be placed in baseboards and, as those up above, will be flush with the wall and painted colors to blend or harmonize with the interior decorating. A two-car garage, as an annex to the house, will be heated.

ASRE and ASHVE Groups Meet Jointly

DETROIT—Members of the Michigan chapter, ASHVE, and the local section of the ASRE, held a joint meeting at the new Springwells Pumping Station of the Board of Water Commissioners November 11, as guests of A. C. Wallich, Universal Cooler Corporation, president of the Board of Water Commissioners and president of the Michigan chapter, ASHVE.

Dinner was served at the plant for members and their wives. Mr. Wallich and the chief engineer at the plant conducted the association members through the pumping station, which was in operation.

Oil Consumption for Heating Increases 20%

WASHINGTON—According to a report recently issued by the Bureau of Mines, the sale of fuel-oil in 1934 was over 20% above that in 1933. There was a steady increase in demand for heating oils since 1931.

The figures for the period from 1930 to 1934 in thousands of barrels of 42 gal. are as follows: 1930, 43,279; 1931, 40,578; 1932, 44,264; 1933, 50,140; 1934, 60,822.

Some of the oil companies in reporting their sales of heating oils found it impossible to separate commercial and domestic grades. For this reason all heating oils from No. 1 to the heavy commercial heating grades are included in the above figures.

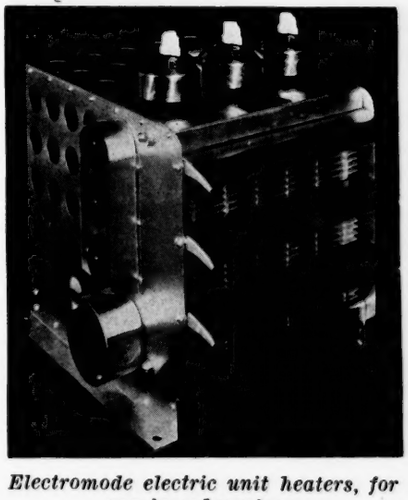
Range oil which is usually a partly refined kerosene used chiefly in the New England area for cooking, space heating and water heating, showed more than a 50% gain in demand in 1934 as compared with 1933. Sales of range oil, which are not included in the heating oil figures, were reported as 15,756,000 bbl. in 1934, compared with 10,269,000 bbl. in 1933, and 6,841,000 bbl. in 1932.

Kelvinator Merges Boston Offices

BOSTON—Merging of the air conditioning and automatic heating departments of the Kelvinator Corporation's Boston division is announced by Harry Troutwine, factory branch manager. G. H. Rittenhouse remains as sales manager, and Everett R. Ryan as chief engineer.

Electric Heat for Submarines

MISHAWAKA, IND.—Electromode electric unit heaters have been adopted by several governments for heating submarines. The Electric Air Heater Company, Division of the American Foundry Equipment Company, has just received an order for 33 of its 4 kw. heaters for submarines being built by the Electric Boat Company.



Electromode electric unit heaters, for use in submarines.

75° Design Wet Bulb Recommended for Cleveland

CLEVELAND—President John Howatt of the ASHVE was the guest and principal speaker at the Cleveland Chapter meeting October 10. Mr. Howatt spoke on "Standards for Air Conditioning," which he described as a device in the hands of the buyer so that he can evaluate his purchase.

In answer to the question "Why Have Standards?" Mr. Howatt replied that the popularity of air conditioning has brought into the field manufacturers and engineers not qualified nor experienced enough to handle air conditioning work. Also, he pointed out, the public must have a measuring stick. He added that the local chapter should assume that responsibility and sponsor a set of standards for the community.

The chapter's committee on standards was presented and recommended that the design wet bulb temperature for Cleveland be changed from 73° to 75°. This recommendation was based on an investigation last summer by the committee individually and collectively. This committee has been continued for the purpose of establishing standards on air conditioning for the city of Cleveland.

Surgical Instrument Store Ice Cooled

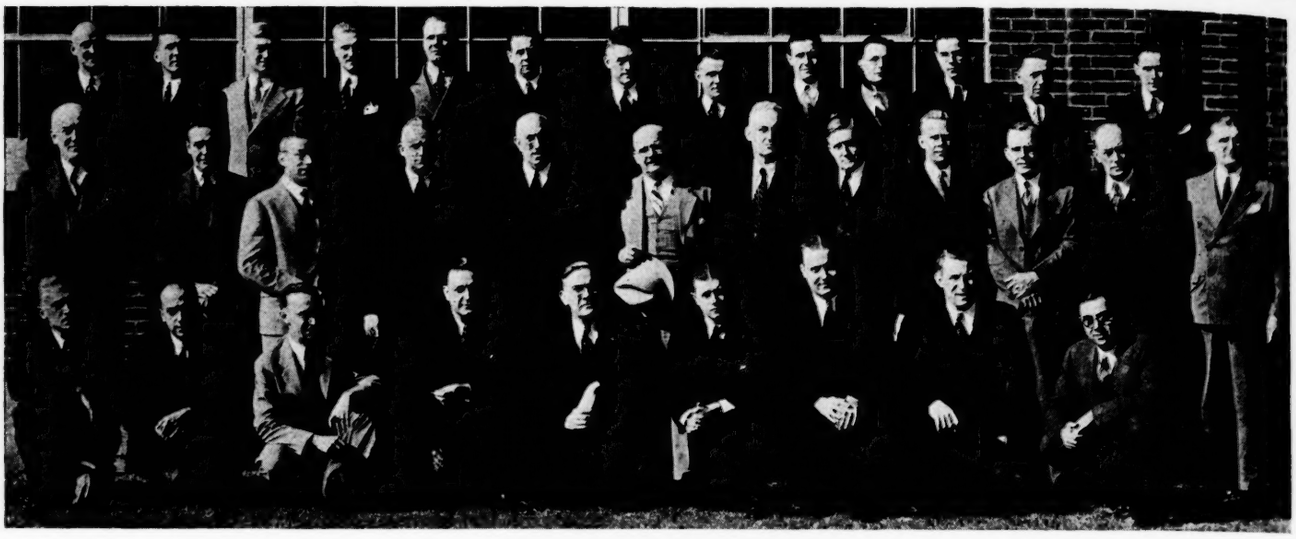
BOSTON—The Thomas W. Reed Company store here is the only air conditioned surgical instrument store in the country. The system uses ice, and was engineered by the Boston Ice Company. Provision is made for tying in with the heating system when desired, by making certain alterations in the heating arrangements.

Equipment consists of a lift-cover ice bunker of steel, cork, and cement, of 1-ton capacity, a water spray for cooling recirculated air, one fan placed on top of a wall stock case and another at the front end of the store on the floor. Together the two have a total capacity of 3,000 c.f.m. of air. Cost of the installation was $600. Ice used during the past summer averaged 1,200 lb. daily.

New Washington Chapter Meets

WASHINGTON — The newly organized Washington chapter of the ASHVE held its second meeting November 18 at the Harrington hotel. W. L. Fleisher was the principal speaker of the evening. His visit was an official one and he spoke as a member of the research committee of the Society.

The chapter received its charter in October and held its first meeting October 9. At that time Lt. Col. W. A. Danielson was elected president, T. H. Urdahl, vice-president; M. D. Kiczales, secretary, and W. E. Kingswell, treasurer. They will hold office until January 1, 1936.



YORK BRANCH MEN MEET AT FACTORY

A vigorous sales program on air conditioning was decided on in the annual fall meeting of York Ice Machinery Corporation's regional, branch and sales managers during the week ending October 26 at York, Pa. During the same week, branch engineers also convened at the factory. Branch managers and company executives shown in the above photograph are: (top row, left to right) R. McJannett, Frank Devers, E. F. Edwards, J. B. Breen, Roscoe Warnock, M. M. Crout, A. C. Edwards, G. H. Cress, Paul Carlson, J. D. Smith, J. T. Schaefer, R. B. Meisenhelder, and J. G. Kuester; (middle row) W. E. Becker, R. H. Beck, F. A. Weisenbach, S. E. Lauer, W. S. Shipley, John Schurman, W. L. Hutton, G. A. Westerlin, C. A. Pearson, W. S. Stair, J. F. Watt, and J. L. Rosenmiller; (front row) W. A. Pusch, L. S. Davis, H. E. Aughenbach, C. R. Logan, H. S. Yoder, F. J. Marshall, R. C. Follett, H. V. Shipley, and M. S. Lebair.

National Better Business Bureau Urges More Careful Use of Term "Air Conditioning"

NEW YORK—So much misuse of the term "air conditioning" has occurred in the advertising and selling of products over the past year or so, that the National Better Business Bureau, in the interest of the consuming public, has issued the following statement:

Literally, anything which affects the atmosphere within a structure, such as an electric fan, the opening or closing of a window, a heated radiator, a pail of water, smoking, flowers, and innumerable other factors "condition" the air to a certain extent.

If there were no industry offering something which it sold to the public as "air conditioning," there might be no objection to describing any of these acts or articles as "air conditioners."

But since something called "air conditioning" is being advertised and sold to the public, it is in the interest of both fair competition and the public that there be a mutual understanding of what this term means. For this reason the National Better Business Bureau has made a careful inquiry into the subject with a view toward defining air conditioning for the guidance of all who are interested in maintaining public confidence in advertising.

We find agreement among the manufacturing industry, architects, and heating and ventilating engineers that "air conditioning," generally speaking, is the scientific preparation and simultaneous control of the atmosphere within a structure. The atmosphere is affected by such factors as temperature, humidity, motion, distribution, dust, bacteria, toxic gases, and ionization. The three factors which probably affect human comfort to the greatest degree are temperature, humidity, and motion of the air. It is the simultaneous control of these three factors which scientific authorities agree constitutes the minimum requirements for air conditioning. Because the functions performed for air conditioning in the summer differ from those required in winter and because units are offered to the public which produce air conditioning in the summer, but not in the winter and vice versa, the following classifications and minimum requirements of air conditioners have been adopted by the trade, scientific authorities, and the National Better Business Bureau:

Summer Air Conditioning should perform, as a minimum, the following functions:
(1) cool the air,
(2) dehumidify the air,
(3) circulate the air.

Winter Air Conditioning should perform, as a minimum, the following functions:
(1) heat the air,
(2) humidify the air,
(3) circulate the air.

Year 'Round Air Conditioning should perform, as a minimum, the following functions:
(1) cool and dehumidify the air in summer,
(2) heat and humidify the air in winter,
(3) circulate the air.

It is understood that the functions required by the season of the year are performed automatically and simultaneously to meet the specific minimum requirements of the user.

The Bureau requests the cooperation of all interested in fair advertising in eliminating the use of the term "air conditioning" or "air conditioner" or "air conditioned" to describe such articles as fans, humidifiers, odor absorbers, underwear, hats, etc. Loose terminology of this nature may not necessarily deceive the public but it paves the way for a manufacturer who may wish to cut corners to offer to the public air conditioning equipment which does not perform the minimum functions of air conditioning as generally understood by the trade; justifying his deception by claiming that the term "air conditioning" has no exact scientific meaning.

Recently the Federal Trade Commission considered a case where the manufacturer of a radiator evaporator claimed to be selling an "air conditioner." After due investigation into the proper use of this term, the Commission issued the following release:

> "Unfair advertising through use of the words 'air conditioner' to describe a device which is not an air conditioner, as those words are generally understood in the trade, will be discontinued by George Landon and Michael Mason Warner, of Chicago, trading as Landon and Warner, under a stipulation entered into with the Federal Trade Commission.
>
> "Landon and Warner agree that in selling a humidifier they will not use in their advertising matter the words 'air conditioner.' The stipulation points out that the respondents' apparatus performs only one of the functions of an air conditioner, namely, that of supplying humidity."

The Bureau recommends that publishers, advertising agencies, and advertisers apply the definitions given herein in the censorship and preparation of advertising copy.

NATIONAL BETTER BUSINESS BUREAU, INC.

Stoker Manufacturers Outline Program at Annual Meeting

CHICAGO—The eighteenth annual meeting of the Stoker Manufacturers' Association was held at the Edgewater Beach Hotel, Chicago, November 15-16. A definite program was outlined which will require several years perhaps to consummate in view of its broad scope and difficult problems to be undertaken for investigation and application.

Some of the major projects in the program for the coming year are highly technical and will probably require considerably more time than one or two years to successfully achieve. The engineering committee recommended, and received unanimous approval of the association, to review the Midwest Stoker Association setting heights standards for steel boilers. These standards were approved and adopted by the Stoker Manufacturer' Association five years ago. Revised standards will be drawn up in the light of improved practices and five years' additional experience in the installing of stokers as well as to factors concerning recent improvement in design and application of underfeed stokers. These setting heights deal with placement of a boiler from the floor level in order to secure ample and proper combustion space within the furnace. The aim of the association is to standardize for universal application the application of boiler setting heights to stokers of modern and more efficient design. Setting heights for cast iron boilers, a new project, will also receive the attention of the association's engineering committee. This activity will require careful study and close application in cooperation with the manufacturers of cast iron boilers.

The association voted unanimously to promote standardization of stoker sizes, both as to coal burning rates and capacities for steam and hot water radiation.

Through the association's commercial committee, of which B. O. Fink, Auburn, Ind., president, Auburn Stoker Corporation, is chairman, an attempt will be made to seek improved reports on stoker sales and production, on data furnished monthly to the U. S. Department of Commerce, Bureau of the Census, by the members now reporting statistics to the Government as well as other members of the industry. Officials of the Census Bureau have pledged their cooperation in revising the monthly stoker sales report, but no action will be taken until the industry guarantees the furnishing of data on the new basis for the past five years in order to preserve the comparative feature of the report. The value of this government report is increasing all the time and is constantly used by the coal and stoker industries and allied lines as well as by business and economic experts in pointing out the fast increasing sales of automatic coal heat devices as compared with sales of competitive fuel burners.

The educational activities of the association will be continued and increased. During the past year many members of the engineering committee of the SMA appeared on a number of programs at various universities and at coal association conventions. The commercial committee is also giving consideration to the publication of a comprehensive catalog featuring the latest improvements and data on stoker firing which can be distributed to engineering students in schools and universities and which can also be used by coal operators, consulting engineers, architects, retail coal distributors, and consumers as a guide in determining the best uses of the various types of stokers manufactured by members of the association.

H. H. Kurtz was continued as the official representative of the association on the Committee of Ten, Coal & Heating Industries, with R. C. Goddard, Springfield, Ohio, president, Combustioneer, Inc., and chairman of the association's membership committee, as alternate. The association voted to continue its financial support of the Committee of Ten activities in 1936.

At the closing session of the convention, all officers for the ensuing year were reelected. These are Col. J. R. Whitehead, Chicago, manager, stoker and research divisions, Fairbanks, Morse & Company, president; R. B. McClave, Scranton, Pa., president, McClave-Brooks Company, vice-president; H. H. Kurtz, Chicago, manager, Chicago, St. Louis and Milwaukee branches, Iron Fireman Manufacturing Company, treasurer; and Marc G. Bluth, Chicago, secretary. The constitution and bylaws were completely revised and a new and smaller executive committee created to permit of greater flexibility in managing the affairs of the association. Members of the new executive committee are: Colonel Whitehead, chairman; Max H. Hurd, Chicago, vice-president, Link-Belt Company; Henry M. Brooks, New York, president, Hershey-Motorstoker Corporation, and president, Pacific Coast Company; E. C. Sammons, Portland, Ore., vice-president, Iron Fireman Manufacturing Company; and L. B. Weller, Baltimore, treasurer, Flynn and Emrich Company.

The annual dinner of the association was held on Friday evening, November 15, with E. C. Sammons as toastmaster.

It was decided to hold the 1936 annual meeting in June, the exact date and place to be selected by the executive committee and announced at a later date.

Oil Burner Show Announced

NEW YORK—The twelfth National Oil Burner Show will be held at Convention Hall, Detroit, Mich., April 14-18, inclusive, according to an announcement made by G. Harvey Porter, managing director of Oil Burner Institute. Complete floor plans, with exhibit space subdivisions and prices, are available at the Institute's headquarters, 30 Rockefeller Plaza, New York. Exhibitors will include burner manufacturers, accessory manufacturers, oil companies, and other related displays. Facilities are available for live exhibits, which are optional. Plans are under way by the Institute to insure large public attendance at the show.

Air Hygiene to be Investigated

PITTSBURGH — Air Hygiene Foundation of America, Inc., has been formed by a large group representing various industries, with headquarters at Thackeray Avenue and O'Hara Street, this city. The purposes of this organization are to conduct investigations of and to stimulate research on problems in the field of air hygiene and to gather and disseminate factual information relating thereto. It will also cooperate with and assist other agencies active in this field and will collaborate in the coordination of such research efforts. A comprehensive investigation has been begun at Mellon Institute of Industrial Research, under support of Air Hygiene Foundation of America, in which the hygienic, technologic, and economic aspects of air contamination, especially by dust in the industries, will be studied.

H. B. Meller, who has been appointed managing director of Air Hygiene Foundation of America, will head this investigation at Mellon Institute. Mr. Meller has been active in research on air pollution since 1920 and is generally regarded as an authority on that subject. During the past fifteen years he has been in charge of the program for the abatement of smoke and dust in the City of Pittsburgh, and since 1923 he has headed the Air Pollution Investigation at Mellon Institute.

Other men taking part in the investigation are Dr. F. F. Rupert, Industrial Fellow of Mellon Institute, and Dr. Samuel R. Haythorn, professor of preventive medicine, School of Medicine, University of Pittsburgh.

Helwig New Head of Engineering Firm

NEW YORK—Alfred Helwig has been elected president and chief engineer of the Electrical Survey and Engineering Corporation, consulting engineers, 424 Madison Avenue. Mr. Helwig succeeds Warner J. Sherb, former president, and Harry P. Wood, formerly chief engineer.

Psychology of A. C. Discussed

DENVER — "The Psychological Effect of Air Conditioning" was the subject of a talk given on November 21 before a meeting in Denver of the Colorado section of the ASME by Philip P. Self, teacher of heating, ventilating and air conditioning in Opportunity High School, vocational center of the Denver public schools system. Mr. Self, while working toward a Master of Engineering degree at Colorado State College in 1933, chose this subject for his thesis and with it won the Charles T. Main award of the ASME in 1934.

In gathering first hand data for his subject, Mr. Self conducted extensive researches on air conditioning and its psychological effect on reaction of students suddenly confronted with examinations. A total of 125 students in five different classes, all registered in freshman algebra, faced a barrage of 22,000 questions in the experiments.

"Two rooms were used in the tests," explained Mr. Self. "One we called the 'test room,' equipped with air washing apparatus, filters, fans, recording wet and dry bulb thermometers, hydrostat and thermostat, both controlled by pneumatic pressure. The other room, called the 'control room,' was identical with the first except that the humidification constant was neglected. Over considerable periods of time the students would alternate between the two rooms so we could have individual comparisons.

"Students were presented lecture material for the first time during the first 45 min. of a 50-min. classroom hour. They were given examinations during the last five minutes. The exams consisted of 16 questions dealing strictly with the subject matter which had been presented in the preceding lecture for the first time. Results were treated statistically by means of individual comparison, and showed that students in a humidified room answered fewer questions, but will answer more correctly. This is explained by the fact that those in the air conditioned room are complacently thinking things out with a cool head, while those in the dry room seem to be under a much greater nervous strain and hurried from one question to the next without working each out thoroughly. These same students when placed in the humidified room definitely became more level headed and answered more correctly a fewer number of questions. We discovered that over a long period of time students in the air conditioned room are very definitely more efficient than those in the old type rooms and their results will be markedly better."

Mr. Self's class at Opportunity is composed of 80 students, half of whom attend a day class and half a night session, and are largely men with years of experience as engineers with large contracting and utilities companies here. The course was first offered last year when eight men asked that it be taught. Today it is one of the most complete offered in any public school system in the United States. After getting his E.E. degree in Colorado in 1926, Mr. Self went to New York City in the employ of a large electrical manufacturing firm until 1932.

H.&H. Sponsors Sales Contest

INDIANAPOLIS—Holcomb & Hoke Mfg. Company, stoker builder, is sponsoring a sales contest for its dealers who make the best record on FireTender sales between now and February 15. Details of the contest are so arranged that dealers with small territories have the same opportunity as those in large territories. A trip to Bermuda for the winning dealer and his wife is the prize.

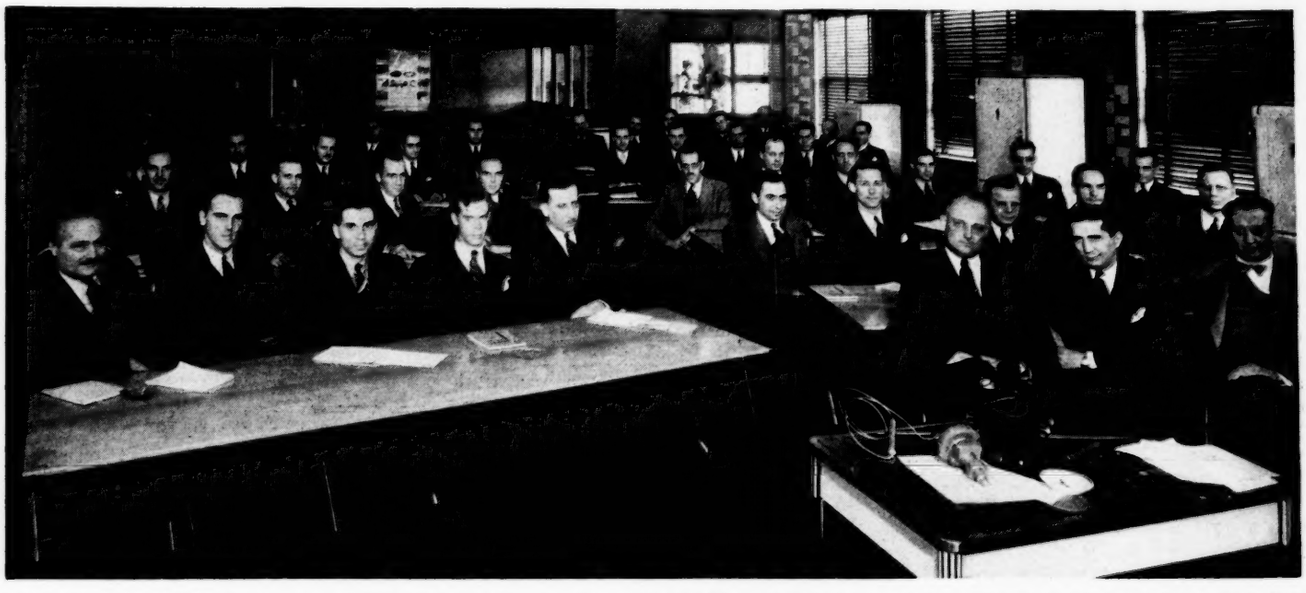
Million for S.P. Conditioning

SAN FRANCISCO—The Southern Pacific has announced that it will spend $1,100,000 on air conditioning in 1936.

Rich Talks on Federal Housing

MILWAUKEE — Edward P. Rich, Chicago consulting engineer, addressed the Wisconsin chapter of the ASHVE at its monthly meeting November 18. Members of the Illinois chapter attended as guests of the local organization. John Howatt, national president of ASHVE, was present.

Mr. Rich's subject was "Heating Design of a Federal Housing Program." He pointed out that government housing projects generally attempt to achieve two results, slum clearance and low rental housing. Of the three housing projects originally contemplated for Chicago, his firm, Neiler Rich & Company, was commissioned to engineer the west side development. The building site constituted 147 acres, being approximately 2,500 ft. square. The proposed buildings were: three, four and five room, three and four story apartments; two story flats; and two story houses. There were 150 separate buildings, a total of 14,700 rooms and a total building cubage of 32,000,000. This original plan was abandoned and a smaller one worked out on a total of 21½ acres. The general design proposed, however, conformed closely to the methods used on the larger plan.



Factory and distributors' air conditioning engineers from many cities attended a week's conference held by Kelvinator Corporation, October 21-25. In the front row are: (left to right) H. W. Burritt, vice-president in charge of sales; J. K. Knighton, manager of the air conditioning sales division, and J. A. Harlan, commercial manager.

George M. Getschow

CHICAGO—George M. Getschow, nationally known heating contractor, president of Phillips-Getschow Company, died November 2. He was 66 years old.

A past president of the Heating, Piping and Air Conditioning Contractors Association, Mr. Getschow was a member for 29 years of the ASHVE. He was also secretary of the Sloan Valve Company and chairman of finances for the Builders and Manufacturers Mutual Casualty Company.

He is survived by a son and a daughter, two brothers, three sisters, and seven grandchildren.

New Officers

CLEVELAND — Officers of the Cleveland Chapter, ASHVE, for the 1935-36 season, are as follows: president, G. L. Tuve: vice-president, E. J. Vermere; secretary, Philip Cohen; treasurer, H. M. Nobis: board of governors, M. F. Rather, F. R. Dickenson, L. T. Avery.

69 Study A.C.

BOSTON—Sixty-nine students are enrolled in heating and air conditioning courses for the school year at Northeastern University.

Pierce, Butler Radiator Corp. Formed

SYRACUSE, N. Y.—Assets and operations of the Pierce, Butler & Pierce Manufacturing Corporation have been transferred to the newly formed Pierce, Butler Radiator Corp., 701 Nichols Avenue. The new corporation will continue to manufacture, sell and service all the products of the former corporation, as well as a line of new products which are being placed on the market.

Newly-elected officers of the Corporation are: President, B. A. McFarlane; vice-president, E. T. McCormack; treasurer, R. A. Zimmerman.

Panel Heating Job in Canada

VANCOUVER, B. C.—The first commercial installation of panel heating in Canada is being made in the new salesrooms of Canadian SKF Co., Ltd., 659 Howe Street, this city. The system, which consists of several large steel panels set into the walls, is made by Comyn Ching & Co., London, England, and was installed by Fred W. Welsh & Son, 1050 Pacific St., Vancouver. The panels are constructed entirely of steel with eight tube sections to each panel, and all inlets and outlets are completely concealed.

COMING EVENTS

JANUARY 27-30, 1936. *National Warm Air Heating and Air Conditioning Association Convention, Hotel Stevens, Chicago, Ill.*

JANUARY 27-31, 1936. *Annual meeting of the American Society of Heating and Ventilating Engineers, Palmer House, Chicago, Ill.*

JANUARY 27-31, 1936. *Fourth International Heating and Ventilating Exposition, International Amphitheatre, Chicago, Ill.*

APRIL 6-11, 1936. *Southern Industrial Show, Textile Hall, Greenville, S. Car.*

APRIL 14-18, 1936. *Twelfth National Oil Burner Show, Convention Hall, Detroit, Mich.*

JUNE 16-19, 1936. *National District Heating Association Convention and Exhibit, Pantlind Hotel, Grand Rapids, Mich.*

Smoke Ordinances to be Enforced

DENVER — Heating men in this city were vitally interested in a meeting held last week by the city smoke commission, chief building inspector Wendell T. Hedgcock, coal dealers and stoker salesmen. A warning was given that the city expected cooperation in its drive to rid the business district and apartment house areas of excessive smoke or it would enforce ordinances providing court action against violators.

Complete plans for the installation of all heating apparatus in commercial buildings and residences housing more than two families must be filed with the chief building inspector before building permits can be issued, according to one of the municipal codes. Stoker salesmen were told they will be held directly responsible for correct installation and operation of apparatus which they sell, as regards its efficiency in reducing smoke to a minimum.

Oil Prices Up

NEW YORK—Effective November 15 the Standard Oil Company has announced the following tank car and terminal prices of fuel oils. These prices are an increase of ¼ cent over the former price, and apply to New York, Boston, and Providence:

No. 2 oil, 4¼ cents; No. 4 oil, 4 cents (4¼ cents in Boston); distillate oil, 4¼ cents.

Warm Air Furnace Championed

(Concluded from page 49)

I cannot see why they did not credit the radiator with air cleaning powers. Certainly if the ordinary radiator will produce air motion which compares to the fan operated furnace system, will humidify and control temperatures while the furnace air conditioning system cannot do these things, then they ought to have been able to dig up some idea to persuade the buyer that the radiator cleans the air as well. However, if you cannot make a case by sticking to facts, fiction is the next best method to get sales.

A scoring table that will come close to the actual facts will read like the table appearing below.

I suppose anyone who wades through this article will suppose that the writer is a salesman for furnaces, or a manufacturer of same, but such is not the case. I am just one of the many who have made a living in the heating trades for many years. I have designed, sold, installed, and serviced thousands of heating systems of all types and kinds, used soft coal, hard coal, wood, gas, oil, and electricity for prime fuels, and am just foolish enough to get irritated when I read selling propaganda of the Newton-Coleman type.

	RADIATOR	FAN FURNACE
Heating	Good	Good
Economy	Good	Good
Air motion	Convection currents	Positive
Humidity	Requires special devices at additional cost	Ample
Temperature control	Over runs both ways likely	Good
Air cleaning	No attempt	Filtered air
Partial summer cooling	No attempt	Practical
Mechanical refrigeration	No attempt	Easily added
First cost	High	Moderate
Durability	Good	Good
Living room space	Used by radiators	None
Basement space	Slightly in favor of radiator system	—
Cleaning of system	Boiler to be blown off when installed	None
Water leaks	Air valves to be cleaned annually	None
	Possible in valves or piping	None

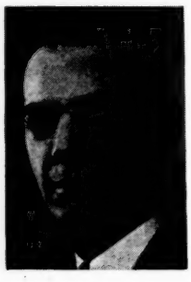
WITH THE MANUFACTURERS • • • •

American District Steam Co., North Tonawanda, N. Y., has appointed Harry T. Porter, 2436 Reading Road, Cincinnati, as representative for Cincinnati and vicinity.

American District Steam Co., North Tonawanda, N. Y., has appointed Edward A. Hahl to its sales engineering staff.

A. M. Byers Co., Clark Building, Pittsburgh, has transferred R. H. Gardner, formerly division manager of its Washington office, to Pittsburgh as manager of steel pipe sales. Simultaneously, E. L. MacWhorter, formerly manager of the company's Philadelphia division, moves to the Munsey Building in Washington, where he will head the combined activities of both divisions now known as the Washington division. District representatives will be maintained, as in the past, in Baltimore and Philadelphia, the latter address now being 1212 Commercial Trust Building.

Combustion Engineering Co., Inc., 200 Madison Ave., New York, announces the appointment of Wilson Machinery & Supply Co., Inc., Lexington, Ky., and William Franklin, Buffalo, N. Y., as representatives of its industrial stoker division for the sale of its stoker units, a line of underfeed stokers applicable to boilers from the small size heating units to power boilers developing up to 400 hp. Industrial Combustion Co., Philadelphia, has been appointed as representative in the territory comprising southeastern Pennsylvania, southern New Jersey and Wilmington, Del., for this line of stokers.



Crane Co., Chicago, has appointed H. H. Simmons as advertising manager, effective November 15. In cooperation with other aids to selling, such as exhibits, dealer service, special campaigns, and sales training, he will develop the advertising service so that it can be fitted into the general sales promotional program. Mr. Simmons was for nine years with Russell T. Gray, Inc., Chicago advertising agency, of which he has been vice-president and account executive. He is a graduate of University of Illinois in civil engineering.

Davis Engineering Corp., Elizabeth, N. J., has appointed George Robinson as sales engineer for the company's boiler department covering Brooklyn, Queens, and other Long Island territory. Present policy of the company on its automatically fired boilers will provide factory representation in every territory of sufficient size.

C. A. Dunham Co., Chicago, announces that C. P. Finke, formerly secretary and treasurer of the Optenberg Iron Works, Sheboygan, Wis., resigned that office early in November to associate himself with Dunham's sales organization in Milwaukee. Mr. Finke is nationally known in the heating trade by reason of his long service in various capacities with the Heating, Piping and Air Conditioning Contractors National Association.

Inland Steel Co., Chicago, has appointed Keith J. Evans manager of the sales promotion division. Mr. Evans will be in charge of the company's advertising, sales statistics and commercial research. He has served in a similar capacity with Joseph T. Ryerson & Son, Inc., since 1917, and will continue to do so in addition to his new position with Inland Steel Company. He will have offices at both establishments.

The Kennedy Valve Manufacturing Co., Elmira, N. Y., has appointed Frank De Witt & Co., 5736 Twelfth Street, Detroit, as its representative in the lower peninsula of Michigan including Detroit.

Liberty Foundry Co., 7600 Vulcan St., St. Louis, has purchased the assets and goodwill of the Symonds Register Company from the estate of the late Herbert Symonds. The line includes baseboard and wafer registers and cold air returns.

The Lincoln Electric Co., Cleveland, Ohio, has opened new offices in Peoria, Ill., and Memphis, Tenn. The former, located at 923 South Washington Street, is under the direction of W. I. Miskoe, who has been transferred from the Chicago sales office. The Memphis office is under the direction of O. B. Farrell. The company also announces that Lewis S. Hinchman has been transferred to the Chicago district sales office, while Paul M. Corp is now located at the Milwaukee office.

Motor Wheel Corp., Lansing, Mich., announces that its board of directors has elected M. F. Cotes, for the past three years manager of the heater division, vice-president of the corporation in charge of the heater division.

Republic Steel Corp., Youngstown, Ohio, has appointed Robert J. Working as district sales manager in the Birmingham, Ala., territory, succeeding Kenneth D. Mann who has resigned to become executive vice-president of Truscon Steel Company. Paul R. Johnston has been named district sales manager in the Cincinnati territory, succeeding Mr. Working. Charles W. East, formerly of the Birmingham office, has been named assistant manager of sales in Republic's pipe division, succeeding George E. Clifford recently appointed district sales manager for Republic in the Los Angeles territory.

Surface Combustion Corp., Toledo, announces the appointment of W. J. Grover as advertising manager to succeed D. H. Bacon, who has resigned in order to associate himself with an advertising agency. Mr. Grover returns

W. J. Grover

to Surface Combustion after serving two and one-half years as sales director and in the research and sales planning division of The Peoples Gas Light and Coke Company of Chicago.

H. A. Thrush & Co., Peru, Ind., has appointed R. E. Lund as direct factory representative in charge of the New England territory, with headquarters at Boston. E. D. Noland, who has been factory representative in that territory, is being returned to the factory on the general office staff. These changes are effective January 1.

Warren Webster & Co., Camden, N. J., has appointed John F. Hanbury as manager of its New York office at 470 Fourth Avenue, succeeding the late William M. Treadwell. Mr. Hanbury has been associated with the company for more than 16 years, is a native of New York City, and a graduate in mechanical and electrical engineering.

York Ice Machinery Corp., York, Pa., has appointed John R. Hertzler as manager of its air conditioning division. Prior to his appointment, Mr. Hertzler was manager of the air conditioning division of the New York branch of the company.

Young Radiator Co., Racine, Wis., has appointed F. W. Bowers as plant manager.

NEW EQUIPMENT

Mercoid Pressure-Low Water Control

The type DA-121 combined pressure and low water control has been announced by The Mercoid Corp., 4201 Belmont Ave., Chicago. It is designed especially for automatically fired steam boiler installations. The pressure control part of the combination unit incorporates the Bourdon tube principle, with the pressures between which the control operates adjustable as shown in the illustration. Adjustment can be made from the outside. Pressures can be seen through the dial. A locking device is provided and may be sealed to prevent tampering. The standard range is from 0 to 14 lb. with a minimum differential of 1 lb. It is also available at extra charge with a range from 10 in. of vacuum to 12 lb. pressure.

The instrument faces to the front of the boiler which makes it easy to get at the adjustments. The cast iron housing contains a copper float. When the water falls too low in the boiler the float actuates the switch to stop the boiler. Switches are all Mercoid.

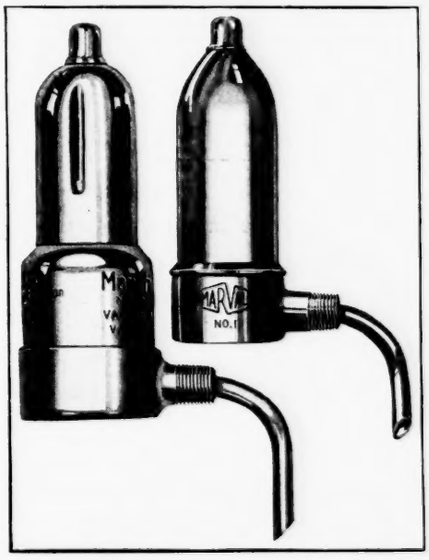
Two methods of hooking up are possible, one with the top outlet leading to the supply outlet of the boiler, the bottom outlet to the return. A quick hookup is possible by extending the gauge glass connections into the top and bottom of the combination cutoff. Standard hookup fittings for this purpose are available and this hookup is recommended for installations except those in localities where the water supply has a heavy lime content or excessive foreign matters, such as silt.

Marsh No. 2 Air and Vacuum Valve

Jas. P. Marsh Corp., 2073 Southport Ave., Chicago, Ill., has announced the Marsh No. 2 air and vacuum valve. It is constructed with two separate chambers and a cap. In the lower chamber is contained the inlet of the valve, the primary float, the thermostatic diaphragm which also functions as secondary or high vacuum diaphragm and the first or large venting orifice. The syphon is also connected to this lower chamber.

In the upper chamber is contained the secondary float, the primary vacuum diaphragm and the upper or increased venting orifice. In the cap is contained the light disc.

As steam condenses a vacuum is formed within the radiator and the valve. This draws the vacuum check against its seat. As the vacuum deepens, the primary vacuum diaphragm functions in the following manner: atmospheric pressure at room temperature is sealed within the upper or secondary float. As vacuum is formed within the valve, the difference in pressures is sufficient to cause expansion of the upper or primary vacuum diaphragm and raises the upper valve pin against the upper or increased orifice



seat, closing it tightly. As the depth of vacuum increases, the pressure of the diaphragm also increases, holding the valve pin more tightly against the orifice seat.

Should the lapse of time between firing periods be prolonged and a much deeper vacuum formed, the lower or secondary vacuum diaphragm will be expanded, raising the lower valve pin against the seat in the lower orifice.

The "triple vacuum seat" is then functioning to prevent entry into the valve and system.

When additional steam is introduced into the radiator and the vacuum recedes, the lower mechanism will react first and be ready to function once more as the thermostatic diaphragm or primary float. Then, as the vacuum further recedes, the primary vacuum diaphragm contracts, leaving it to the vacuum disc to hold any remaining vacuum, or where air is to be expelled, permitting the disc to be raised by the slightest pressure and air is expelled.

The valve is available with ⅛ in. standard angle pattern connection for cast iron radiators, and with ⅛ or ¼ in. male thread straight connections for convection radiators, and with a ¾ in. male thread straight connection in addition to a ⅜ in. female thread tapped into the connection for piping applications.

Lectrodryer Dehumidifier

Pittsburgh Lectrodryer Corp., P. O. Box 1776, Pittsburgh, Pa., has introduced a line of Lectrodryer equipment for dehumidification. This equipment is built in two types. The industrial type is for drying air and gases to bone-dry conditions.

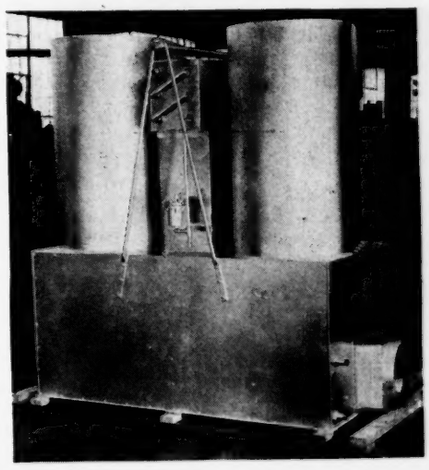
The air conditioning type units are used for dehumidifying large volumes of air, such as in maintaining lower than normal relative humidities in storage warehouses, process rooms, packaging rooms where hygroscopic salts are handled, and for comfort conditioning in restaurants, offices, and factories.

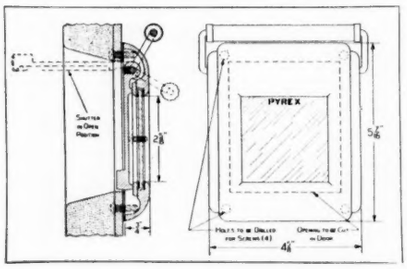
Moisture is removed by adsorption. Activated alumina, a product of the Aluminum Company of America, is used as the adsorbing agent. This is a solid adsorbent.

Removal of moisture by adsorption simplifies the mechanism of moisture removal and results in operating economies claimed not to be possible with other types of low humidity maintenance equipment.

Lectrodryers may be obtained for reactivation by gas, steam, or electricity.

Standard equipment for air conditioning includes automatic mechanism to assure a constant output of dried air. Aftercoolers of sufficient capacity are provided so that the outlet air temperature is cooled to a point within the comfort zone.





National Observation Port

National Radiator Corp., Johnstown, Pa., has placed on the market an observation port for installation in the firedoor of a heating boiler to provide a visual check-up on combustion.

The port consists of a cast frame bolted to the firedoor over an asbestos gasket. An opening in the center of the port is equipped with heat resisting glass plate, held in place by two asbestos gaskets. The glass is shielded from the flame and protected against sooting by a positive action shutter or damper, normally closed, which can be opened at will by an asbestos-protected handle. As soon as the handle is released, the counter-weighted shutter automatically returns to its closed position.

It can be attached to any boiler by cutting an opening through the firedoor and drilling four bolt holes.

Vallen Ventilaire

Vallen Electrical Co., Inc., Akron, Ohio, has introduced the Ventilaire, a two-bladed fan with a slight forward curve at the blade tip and with an adjustable blade pitch. By adjusting the pitch of the blade the velocity and volume of the air can be compensated for to take care of the differences in the specific gravity of fumes, heated air, moist air, smoke, dust, etc.

The fan is designed for introduction into a duct and with the axis of rotation at right angle to the axis of the motor which is geared through an extended arm.

The whole unit may be suspended from the duct. The necessary support for the motor is possible by mounting the aluminum base on the wall, ceiling, or floor, or by suspending it from supports attached to the duct system. The fan is said to have a low watt input relative to its capacity.

Arco Vecto Heater

Introduction of a circulating heater for small homes, the Arco Vecto heater, to serve the dual purpose of permitting heating contractors to capitalize on the demand market for this type of product and at the same time bring to their stores prospects seeking this type of heater whose purchases can be converted to the purchase of a radiator heating system, has been announced by American Radiator Co., New York.

Patterson Fuel Oil Heaters

The Patterson-Kelley Co., East Stroudsburg, Pa., is marketing three types of fuel oil heaters used for heating fuel oil before it is burned in order to reduce its viscosity and assist the atomization of the oil.

The heaters are available in two types. Type O heaters, with straight tubes, are designed for either vertical or horizontal operation. They are of the multipass design. The shells, tubes, and tube sheets are of steel and the rear head casting is of semi-steel. The oil chamber is of steel, being formed by an extension of the shell. This construction permits the oil connections to be made perpendicular to the length of the heater and by simply removing the bolted cover at the end, the tube ends are exposed without breaking any pipe lines.

The tube sheet at the rear end is welded to the end of the shell. Welding both tube sheets to the shell eliminates gaskets at these points.

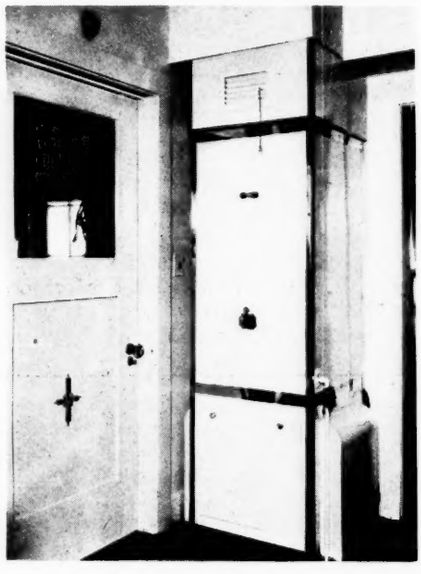
The second type, D, has U tubes and is used for lighter oils and lower pressures.

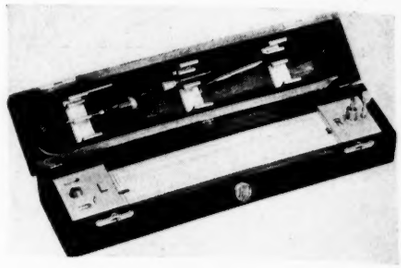
A third line, the suction type, is designed for installations in oil storage tanks to heat the oil as it is being withdrawn. These are built specially for a given installation.

Marvelaire

The National Heating & Engineering Co., San Diego, Calif., is marketing the Marvelaire, a gas fired winter air conditioning unit. The design and arrangement permit placing the heater on the porches or in a small closet or cupboard. High velocity air distribution permits locating the heater at a distant point from the room being heated. A filter is included.

The blower may be operated in the summer for circulation by setting a small switch on the thermostat.





Friez Air Meter

Julien P. Friez & Sons, Inc., Baltimore, Md., has placed on the market an air meter designed for the direct measurement inside of ducts of pressures and vacuums from 0.00125 in. to 0.50 in. of water and velocities from 140 to 2,832 f.p.m.

The meter is self-contained in its wooden carrying case and the zero and leveling devices are integral parts of the instrument. Readings are obtained inside of ducts by inserting the metal testing tube into a small hole in the ducts.

Hexcel Electric Heater

Hexcel Radiator Co., Racine, Wis., announces a hot water portable electric room heater. This is a small unit, weighing 12 lb. and measuring 13½ high x 7½ wide x 6 in. deep. It is finished in black crackle with trimmings, handle, and grille of polished chromium.

The heater is composed of the Hexcel all-copper twin core, such as is used in automobile hot water car heaters. The tanks are drawn brass and the heating element, rated at 8.5 amperes at 115 volts, is entirely immersed in the liquid in the bottom tank.

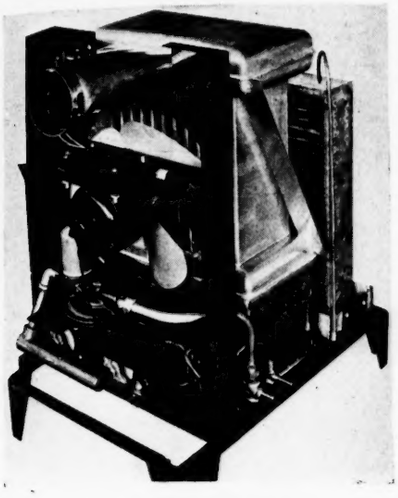
The housing is drawn of heavy gauge steel and the base is of cast iron. The motor is 110 volt, 60 cycle a.c., with no radio interference. A 6-in. aluminum fan gives an air velocity of 260 f.p.m. The heater is equipped with an 8-ft. asbestos cord with rubber wall plug.

Arco Oil Boiler No. 11

Arco oil burning boiler No. 11, a cast iron sectional boiler designed for the small home, has been placed on the market by American Radiator Co., New York, for use as a component part of its heating systems or for modernization.

A companion to the company's No. 12, the new boiler is furnished in six sizes and is built for installation with either gun or rotary type burners. A built-in Taco water heater, with a capacity of 40 and 100 gal. for year 'round hot water supply, and a built-in boiler protector are offered as part of the unit if desired.

The boiler has a capacity of 355 to 755 sq. ft. of installed steam radiator.



Floorflo Gas Heater

The Trane Co., La Crosse, Wis., has announced the gas fired Floorflo heater, developed in conjunction with the Peoples Gas Light & Coke Co., Chicago. The unit is adaptable for homes, apartments, stores, offices, and factories.

The working parts of the heater consist of an all aluminum heat exchanger, burners, a safety pilot control valve, gas pressure regulator, and automatic supply valve, fans, motors, solenoid control valve, and a limit control switch which automatically cuts off the gas supply in the event of overheating. An automatic pilot switch is another safety control device which prevents opening of the gas valve in the event of power failure.

The cabinet has been expressly designed to fit into the home, closely resembling a piece of fine furniture, but the unit without legs may be had in a suspended type for store and industrial installations.

A feature of the heater is the grille, which has a large free area and because the fins are set at an angle, the heat is directed down to the floor line. The unit may be equipped with humidifiers if desired. The smallest size unit has 35,000 B.t.u. per hr. input capacity.

Hermetically Sealed Condensing Units

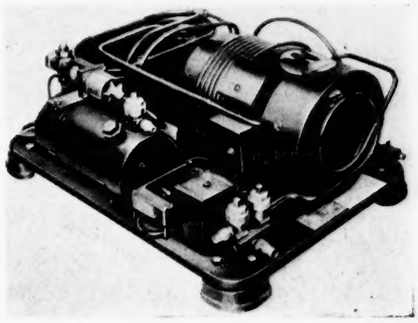
The Westinghouse Electric & Manufacturing Company announces the addition of a new model to its new existing line of hermetically sealed commercial condensing units. This new model, known as the WFB-33H and designed for the use of water as a condensing medium, uses Freon as the refrigerant.

The manufacturer states that due to the hermetically sealed construction, it is possible to water-cool the compressor, condenser and motor. This feature permits the installation of this unit in closets, under counter or back bars, or in fully enclosed and out of the way locations. It is now possible to remove all the heat by the use of water, thus eliminating the necessity for ventilation, as has been required by units not hermetically sealed.

The small compact unit is 24 in. long, 18½ in. wide, 11⅜ in. high and can be built into a cabinet without the use of louvers. A feature of this unit is that there are no exposed moving parts, as all moving parts are sealed inside the shell enclosing the motor and compressor.

The motor is a 1/3 hp. of the capacitor type, directly connected to the two cylinder compressor. The compressor has a bore of 1 in. and ⅞-in. stroke.

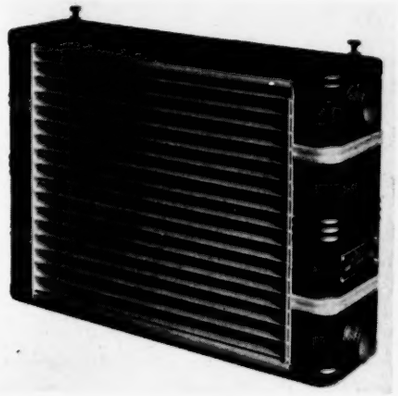
The receiver on this unit is constructed of seamless steel tubing with welded end heads. The end head is equipped with a fusible plug to protect the entire system from explosion in case of fire. The fusible plug has a



discharge temperature of 230°. This receiver is charged with 4 lb. of liquid Freon at the factory.

National Unit Heaters

National Radiator Corp., Johnstown, Pa., has introduced a line of National unit heaters. The casing of the unit is styled for appearance as well as utility. The directional louvers are non-protruding. Aerofin coils are used for the heating surface. Steam supply and return connections are on the side of the unit and the motor bracket is spring suspended.



The units are available in 15 sizes with capacities ranging from 88 to 1065 sq. ft. of radiator at 2 lb. steam pressure.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF MARCH 3, 1933, OF HEATING AND VENTILATING, published monthly at New York, N. Y., for October 1, 1935.

State of New York, County of New York, ss.:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the Treasurer of The Industrial Press, publishers of Heating and Ventilating and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Industrial Press, 140-148 Lafayette St., New York, N. Y.

Editor, C. H. B. Hotchkiss, 140-148 Lafayette St., New York, N. Y.

Managing Editor, Clifford Strock, 140-148 Lafayette St., New York, N. Y.

Business Managers, Robert B. Luchars, 140-148 Lafayette St., New York, N. Y.; Edgar A. Becker, 140-148 Lafayette St., New York, N. Y.; Erik Oberg, 140-148 Lafayette St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Industrial Press, 140-148 Lafayette St., New York, N. Y.; Estate of Alexander Luchars, 140-148 Lafayette St., New York, N. Y.; Louis Pelletier, 140-148 Lafayette St., New York, N. Y.; Erik Oberg, 140-148 Lafayette St., New York, N. Y.; Robert B. Luchars, 140-148 Lafayette St., New York, N. Y.; Edgar A. Becker, 140-148 Lafayette St., New York, N. Y.; Laura A. Brownell, 140-148 Lafayette St., New York, N. Y.; Franklin D. Jones, 140-148 Lafayette St., New York, N. Y.; Elizabeth Y. Urban, 163 Western Drive, Longmeadow, Mass.; Helen L. Ketchum, Atlantic Ave., Cohasset, Mass.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 23rd day of September, 1935.

CHARLES P. ABEL

Notary Public
Kings County No. 250
Kings Register No. 7079
N. Y. County No. 155
N. Y. Register No. 7-A-89
My Commission Expires
March 30, 1937.

Degree-Days and Unit Fuel Consumption—October, 1935

Continuing HEATING & VENTILATING's eighth year of publishing degree-day data for various large cities in the United States

	Atlanta	Baltimore	Birmingham	Boston	Buffalo	Chicago	Cincinnati	Cleveland
Degree-days for October, 1935	96	216	41	348	415	346	266	341
Degree-days, Sept. 1, 1935 to Oct. 31, '35	97	252	41	474	591	440	325	435
Degree-days, Sept. 1, 1934 to Oct. 31, '34	68	258	48	529	532	377	264	406
Degree-days Sept. 1 to Oct. 31, Normal	96	223	0	411	494	356	248	393
Lb. coal per sq. ft. rad., October, 1935..	0.768	1.728	0.328	2.784	3.320	2.768	2.128	2.728
Gal. oil per sq. ft. rad., October, 1935..	0.066	0.148	0.028	0.239	0.275	0.237	0.182	0.234
Cu. ft. gas per sq. ft. rad., October, '35	9.22	20.74	3.94	33.41	39.84	33.22	25.54	32.74

	Denver	Des Moines	Detroit	Duluth	El Paso	Fort Wayne	Grand Rapids	Harrisburg
Degree-days for October, 1935	394	413	425	668	86	388	407	306
Degree-days, Sept. 1, 1935 to Oct. 31, '35	538	500	569	1034	102	490	547	385
Degree-days, Sept. 1, 1934 to Oct. 31, '34	411	395	474	917	17	420	485	379
Degree-days, Sept. 1 to Oct. 31, Normal	500	357	442	881	40	347	476	329
Lb. coal per sq. ft. rad., October, 1935..	3.152	3.304	3.400	5.344	0.688	3.104	3.256	2.448
Gal. oil per sq. ft. rad., October, 1935..	0.271	0.283	0.291	0.458	0.059	0.266	0.279	0.210
Cu. ft. gas per sq. ft. rad., October, '35	37.82	39.65	40.80	64.13	8.26	37.25	39.07	29.38

	Hartford	Indianapolis	Kansas City	La Crosse	Los Angeles	Louisville	Memphis	Milwaukee
Degree-days for October, 1935	346	291	302	475	30	192	101	409
Degree-days, Sept. 1, 1935 to Oct. 31, '35	473	352	349	620	30	225	118	516
Degree-days, Sept. 1, 1934 to Oct. 31, '34	498	297	225	542	42	190	61	492
Degree-days, Sept. 1 to Oct. 31, Normal	392	298	214	558	0	186	62	534
Lb. coal per sq. ft. rad., October, 1935..	2.768	2.328	2.416	3.800	0.240	1.536	0.808	3.272
Gal. oil per sq. ft. rad., October, 1935..	0 237	0.200	0.207	0.326	0.021	0.132	0.069	0.280
Cu. ft. gas per sq. ft. rad., October, '35	33.22	27.94	28.99	45.60	2.88	18.43	9.70	39.26

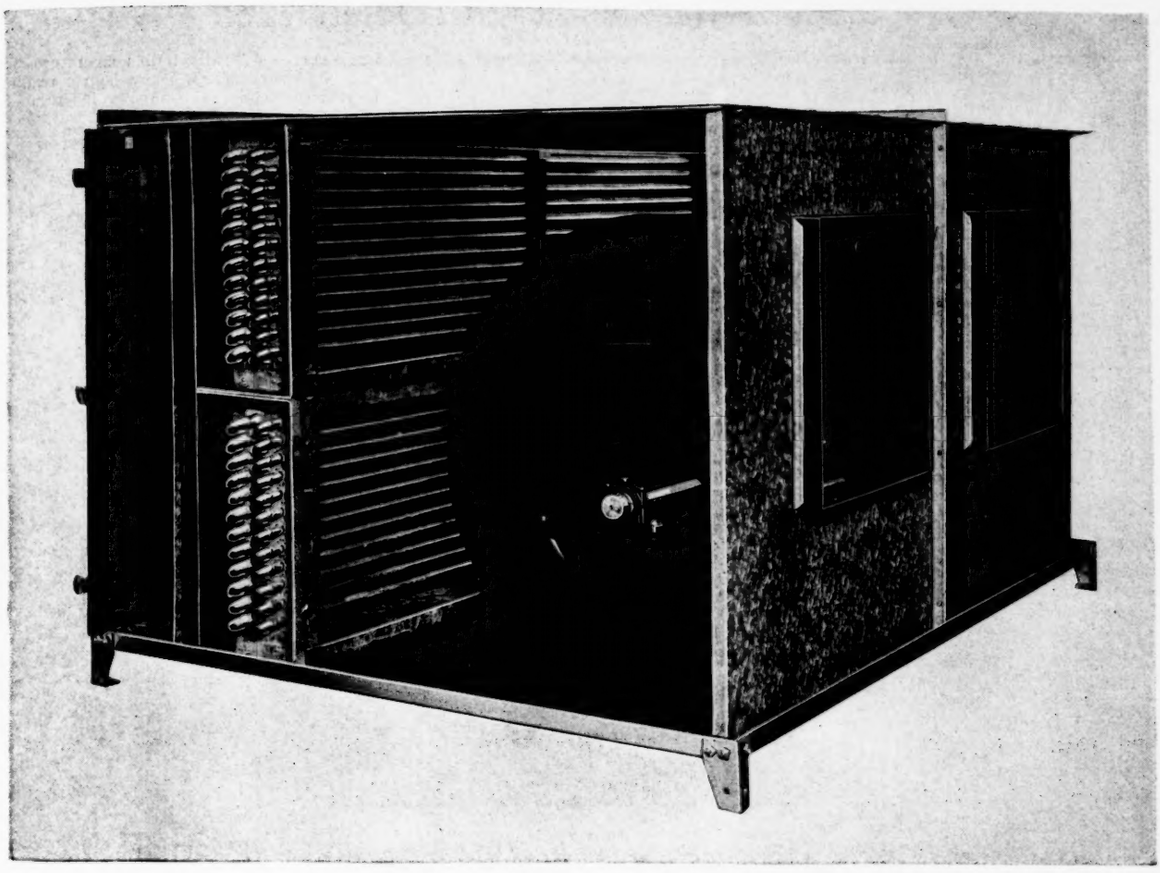
	Minneapolis	New Haven	New Orleans	New York	Oklahoma City	Omaha	Peoria	Philadelphia
Degree-days for October, 1935	509	340	4	255	158	445	346	233
Degree-days, Sept. 1, 1935 to Oct. 31, '35	662	435	4	322	191	525	440	274
Degree-days, Sept. 1, 1934 to Oct. 31, '34	600	451	0	366	90	326	352	288
Degree-days, Sept. 1 to Oct. 31, Normal	574	399	0	276	105	329	384	242
Lb. coal per sq. ft. rad., October, 1935..	4.072	2.720	0.032	2.040	1.264	3.560	2.768	1.864
Gal. oil per sq. ft. rad., October, 1935..	0.349	0.233	0.003	0.175	0.108	0.305	0.237	0.160
Cu. ft. gas per sq. ft. rad., October, '35	48.86	32.64	0.38	24.48	15.17	42.72	33.22	22.37

	Pittsburgh	Portland, Ore.	Providence	Reading	Rochester	St. Louis	Salt Lake City	San Francisco
Degree-days for October, 1935	304	367	360	278	392	237	384	132
Degree-days, Sept. 1, 1935 to Oct. 31, '35	368†	395	462	361	563	275	422	293
Degree-days, Sept. 1, 1934 to Oct. 31, '34	366	358	488	383	527	174	422	203
Degree-days, Sept. 1 to Oct. 31, Normal	313	437	410	344	503	205	406	260
Lb. coal per sq. ft. rad., October, 1935..	2.432	2.936	2.880	2.224	3.136	1.896	3 072	1.056
Gal. oil per sq. ft. rad., October, 1935..	0.208	0 252	0.247	0.191	0.269	0.163	0.263	0.091
Cu. ft. gas per sq. ft. rad., October, '35	29.18	35.23	34.56	26.69	37.63	22.75	36.86	12.67

	Scranton	Seattle	Spokane	Syracuse	Toledo	Trenton	Washington, D. C.	Wichita
Degree-days for October, 1935	385	415	559	390	381	294	228	284
Degree-days, Sept. 1, 1935 to Oct. 31, '35	537	513	658	573	495	368	268	319
Degree-days, Sept. 1, 1934 to Oct. 31, '34	534	484	687	536	432	392	283	179
Degree-days, Sept. 1 to Oct. 31, Normal	457	595	707	521	378	242	251	192
Lb. coal per sq. ft. rad., October, 1935..	3.080	3.320	4.472	3.120	3.048	2.352	1.824	2.272
Gal. oil per sq. ft. rad., October, 1935..	0.264	0.275	0.383	0.267	0.261	0.202	0.156	0.195
Cu. ft. gas per sq. ft. rad., October, '35	36.96	39.84	53.66	37.44	36.58	28.22	21.89	27.26

†The figure 94, appearing in last month's issue as the Pittsburgh degree-days for September, was based on temperatures at the Municipal Airport. From readings at the City Office, which supplies data on which the degree-days are usually based, the degree-days for September were 64. Readings from the City Office Station will be used in the future as they have in the past, and the September figure has accordingly been revised.

Fuel consumption figures given above are based on certain conditions, and for other conditions corrections must be made. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operating at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal, 1000 B.t.u. per cu. ft. for gas, and 140,000 B.t.u. per gal. for oil. To correct for other heating values, efficiencies, and design conditions, follow the method explained in the "Heating and Ventilating Degree-Day Handbook." Degree-days as given above for "a normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.



Use a "PC" Cabinet *for* "Practical Conditioning"

You men who select air conditioning equipment, try a "PC" Cabinet on the next job—a "practical conditioner"—designed and built to do a definite job in an efficient, fool proof manner.

Hundreds of these cabinets are in use—on services ranging from simple summer cooling to complete year-round air conditioning. Because they are flexible as to construction "PC" Cabinets fit every requirement of engineer, contractor and owner. . . . ***Write for Bulletin 2968 which gives complete information.***

Buffalo Forge Company

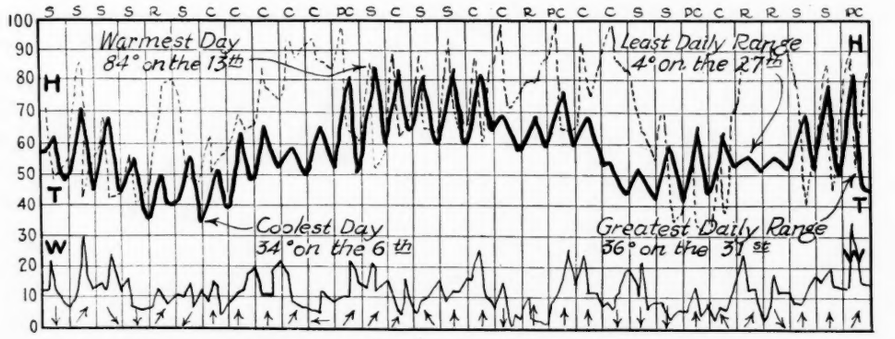
480 Broadway Buffalo, N. Y.

In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" for Air Conditioning, Heating, Cooling, Ventilating

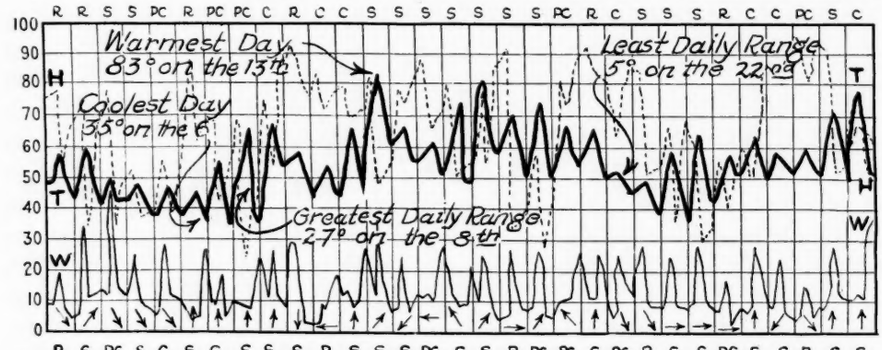
THE WEATHER FOR OCTOBER, 1935

Plotted from records compiled for HEATING AND VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity, from readings at 8 a.m., noon, and 8 p.m., except for New York, which shows hourly readings. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions. S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.



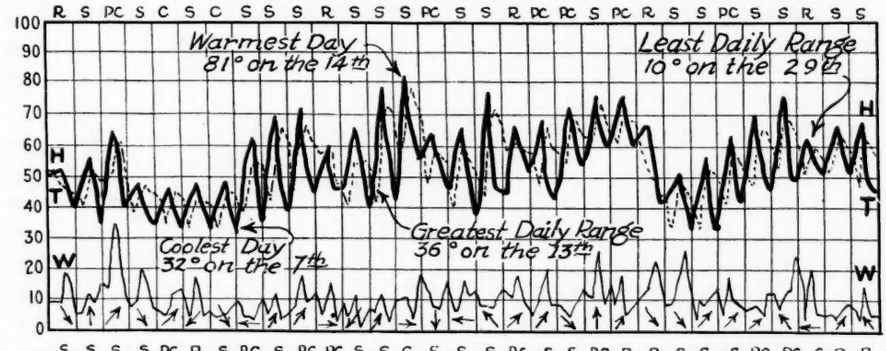
St. Louis

Mean temp. for month, 58.6°; aver. wind velocity, 10.3 m.p.h.; prevailing direction of wind, S.



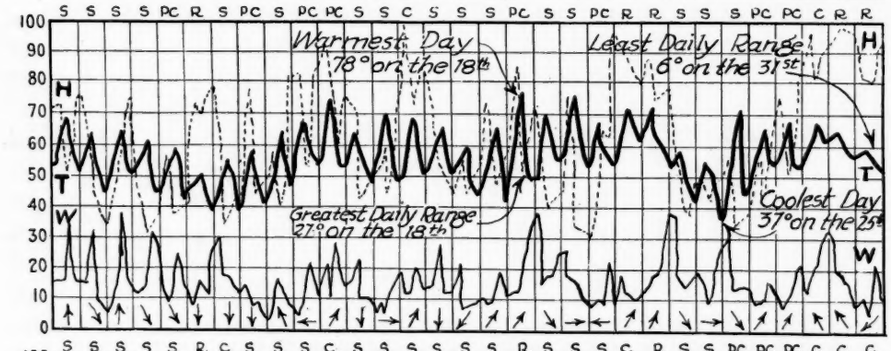
Chicago

Mean temp. for month, 54.2°; aver. wind velocity, 9.6 m.p.h.; prevailing direction of wind, S.



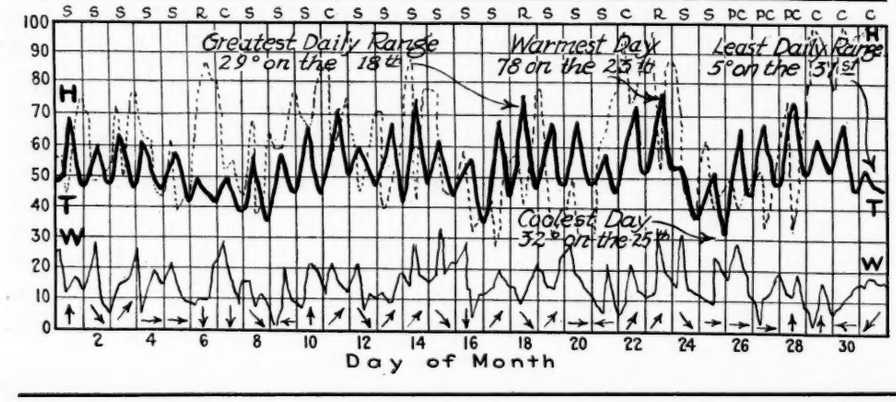
Pittsburgh

Mean temp. for month, 53.8°; aver. wind velocity, 8.9 m.p.h.; prevailing direction of wind, SW.



New York

Mean temp. for month, 56.8°; aver. wind velocity, 14.5 m.p.h.; prevailing direction of wind, NW.


Greatest Daily Range
29° on the 18th
Warmest Day
78 on the 23rd
Least Daily Range
5° on the 31st
Coolest Day
32° on the 25th
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

Boston

Mean temp. for month, 53.8°; aver. wind velocity, 13.6 m.p.h.; prevailing direction of wind, W.

2200 TONS OF AIR PER HOUR

Supplied by Sturtevant Fans and Air Washers in St. Louis Auditorium

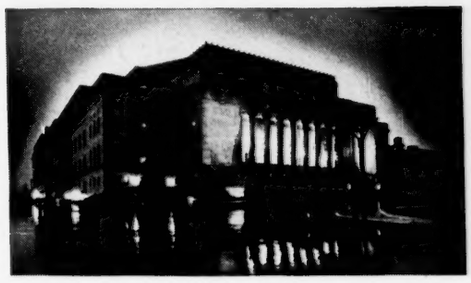
14 Sturtevant Fans supply 980,500 c.f.m. of fresh air, 2200 tons per hour.

32 Sturtevant Fans exhaust 840,000 c.f.m. of air, 1825 tons per hour.

14 Sturtevant Air Washers have a total capacity of 980,500 c.f.m.

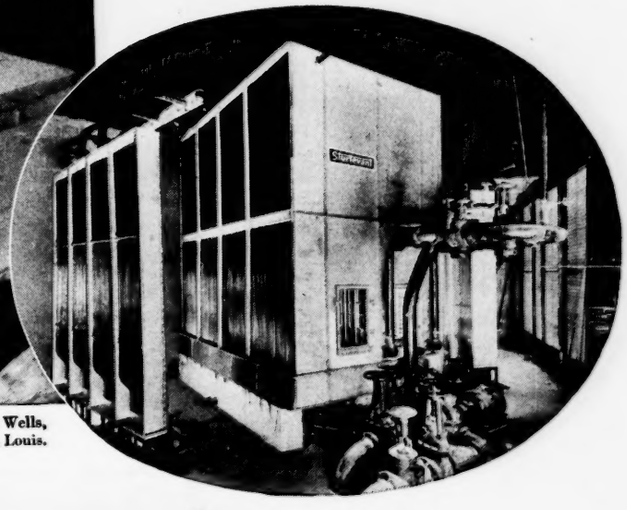
27 Sturtevant Unit Ventilators supplement the above equipment.

Architects: The Plaza Commission, Inc., and La Beaume & Klein. *Engineer:* George E. Wells, Inc. *Heating and Ventilating Contractor:* Midwest Piping and Supply Company. All of St. Louis.



Largest thoroughly air conditioned structure of its type

...is the St. Louis Auditorium shown above which seats over 17,000 people and in which Sturtevant Fans and Air Washers are used. Including supply and exhaust air, as well as air supplied by the Sturtevant Unit Ventilators, a total of about 2,000,000 cubic feet of air per minute will be handled by the Sturtevant Equipment.

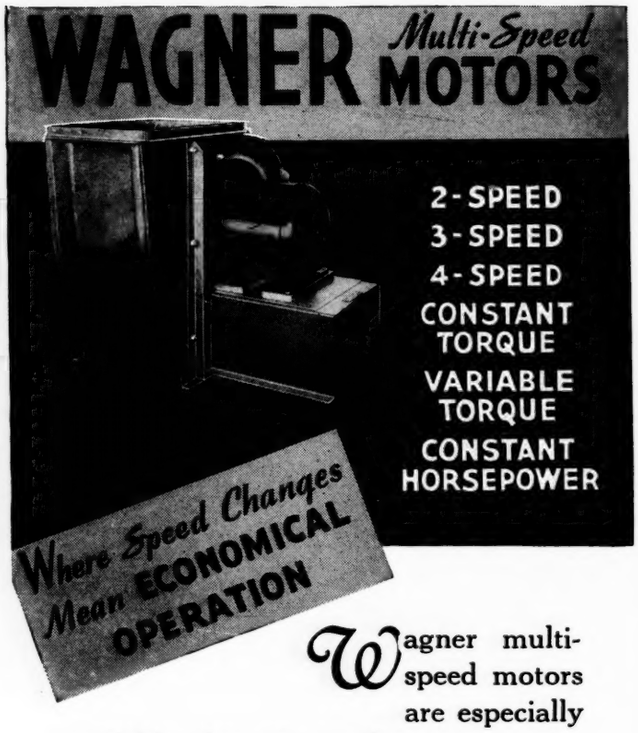


Sturtevant

REG. U. S. PAT. OFF.

B. F. Sturtevant Company, Hyde Park, Boston, Mass. *Branch Offices in 33 Other Cities*
B. F. Sturtevant Co. of Canada, Ltd., Galt. Toronto and Montreal *Representatives in Principal Cities*

Fans, Blowers, Air Washers, Air Conditioning, Heating, Vacuum Cleaning, Drying, Mechanical Draft Equipment



Wagner multi-speed motors are especially suitable for air conditioning equipment, refrigeration systems, blowers, fans, conveyors, compressors, or for any machine where it is desirable to operate at more than one constant speed.

No matter what your motor requirement may be, there's a Wagner multi-speed motor designed and built for the job. They are available in 2-speed, 3-speed, 4-speed, constant-torque, constant-horsepower, and variable-torque; horizontal or vertical; 2 or 3 phase; 25 to 60 cycles; ½ to 125 hp.

The insert above illustrates a Wagner 1½/.67/.39 hp, 3-speed, 1750/1160/870 rpm, multi-speed variable torque motor driving a 3000 cfm exhaust fan. The three operating speeds make it possible to deliver a variable quantity of air, depending upon the weather and other conditions.

Ask for a copy of Bulletin 174 which describes Wagner multi-speed motors as well as other types of polyphase motors.

M335-2

Wagner Electric Corporation
6400 Plymouth Avenue, Saint Louis, U.S.A.
Transformers Motors Fans Brakes

A Million Dollar Modernizing Job

(Concluded from page 37)

Conditions Maintained

The air conditioning guarantee was based on outside conditions of 93° dry bulb and 75° wet bulb temperature in summer, and zero outside winter conditions. The specified inside conditions were 83° dry bulb and 65° wet bulb except in the library, film storages, corridors and vestibules in the north head house on the first floor, and in the first floor auditorium wing.

A dry bulb of 80° and a relative humidity of 50% were specified for the library. The conditions for the film storages in the cooling tower building were specified as 72° dry bulb and 60° wet bulb, throughout the year. The other areas excepted are to be held at 83° dry bulb and 37½% relative humidity. Inside winter conditions are specified at 75° dry bulb and 40% relative humidity.

The people loading is based on a normal of 3,200 persons. The light load is based on 1 watt per square foot of corridor space and 2 watt per square foot of office and other spaces. This includes the complete basement, ground, first and second floors as requiring lighting, and all of the corridors on the other floors.

Provision was made for the handling of 163,540 c.f.m. of outside air during the cooling season.

It was necessary that all work on this installation be accomplished without interference to the Government employes in the building. Very definite times were given as working hours so that the noise would not be objectionable. This naturally necessitated much overtime work at night and on weekends, although it was possible to work in the refrigeration machinery room and do some piping in other parts of the building during normal working hours. Approximately 383 men were working on this installation for a period of several months, the wide scope of the activities providing employment for men from a number of lines.

It was necessary that the factory cooperate very closely with the field engineers in supplying the equipment as needed—not too soon as to pile up, nor too late as to upset the schedule of work.

The completion of this installation, requiring the large expenditure of money, is indicative of the Federal Government's attitude toward air conditioning. The feeling that it is essential to obtain the best work and keep the employes in the best health is definitely stressed by this move.

Industry and Government Join in Promoting New Nationwide Series of Home Shows

(Continued from page 39)

committee's plan, if adopted, is expected to result in construction of at least 250,000 new homes in 1936, 500,000 in 1937, and 750,000 in 1938. In subsequent years the amount of construction is expected to be large enough to produce the estimated average of 750,000 a year over the ten-year period.

The program could function in 1936 and 1937 with the aid of the Federal Savings and Loan Associations, even if no other institutions would be willing to loan

at the rates contemplated by the plan. These institutions, in which the government is a heavy shareholder, have $600 million of assets, besides some $200 million of government reserve, in addition to discount facilities with the Home Loan Bank System.

The building program contemplates reduction of the mortgage loan rate of these associations to 4½% from the existing average of 5½%. The reduction of the insurance rate of the FHA on insured mortgages to ½% of the depreciating balance, instead of the present average of 1% could be obtained through legislation. Such revisions, the committee believes, will result in a flood of private capital available at the same interest rates.

The Committee for Economic Recovery, Inc., is said to be a voluntary, non-partisan, non-political organization of representative business men, supported by voluntary contributions, none of which have yet exceeded $2,500 in any individual case, according to reports.

Automatic Heating 36% Above 1929 Levels; All Indexes Up

(Concluded from page 27)

in Washington where public building work is not so active as it was last year. The ten months' total for 1935 is somewhat behind the total for 1934.

New Building

For October the residential contract total in 37 states, as reported by F. W. Dodge Corporation, amounted to $55 million. This was more than twice the total for October of last year and represented a gain of more than 30% over the September, 1935, total. For the 10-month period ended October residential building amounted to $394 million as against $214 million for the first ten months of 1934. Practically all of this 84% gain was due to private building as distinguished from housing construction of public agencies.

Non-residential building awards during October in the 37 eastern states amounted to $59.4 million as against $49.4 million for September and only $43.7 million for October of last year.

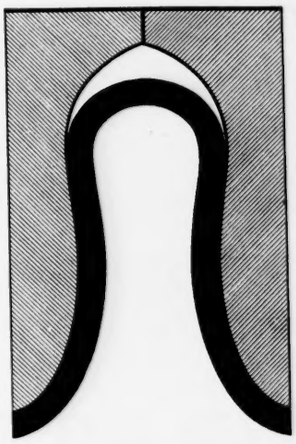
More than twice as many family dwelling units were built during the first 10 months of 1935 as in the entire year of 1934, according to estimates compiled by the U. S. Department of Labor of building permit records from all cities of 10,000 population or upward.

The 9,313 units constructed in October exceeded the October, 1934, record by 158%. From January 1 to October 31, dwelling units provided numbered 66,261, which is 150% more than during the same period of last year and 112% more than in the 12 months of 1934. The September to October gain of this year was 28%.

FHA Statistics

During the week ending November 16, financial institutions with contracts of insurance with FHA reported 28,253 loans under the modernization credit plan, totaling $8.7 million. That brought the total loans reported since the start of the modernization program to 579,831, valued at $212.5 million. This is the largest week's business since the inception of the modernization program in August, 1934.

There is Added Assurance



in the

DIRECTED FLEXING Expansion Joints

TO the casual eye there is no difference between the expansion joint with straight-sided corrugations and one with all-curve corrugations. Actually, there is a vital difference and one that has a distinct bearing on the utility of the two joints. Study the drawing above which depicts the corrugation of the Directed Flexing Expansion Joints made by E. B. Badger & Sons Co. of Boston. Note its all-curve contours. Note, too, the equalizing rings shaped to correspond. This design produces a corrugation that flexes in a wave-like motion. There is no focal point where a curve meets a straight side and stresses localize. With Directed Flexing the whole movement is progressively controlled as well as equalized.

There is added assurance in the Directed Flexing Expansion Joints made exclusively by . . .

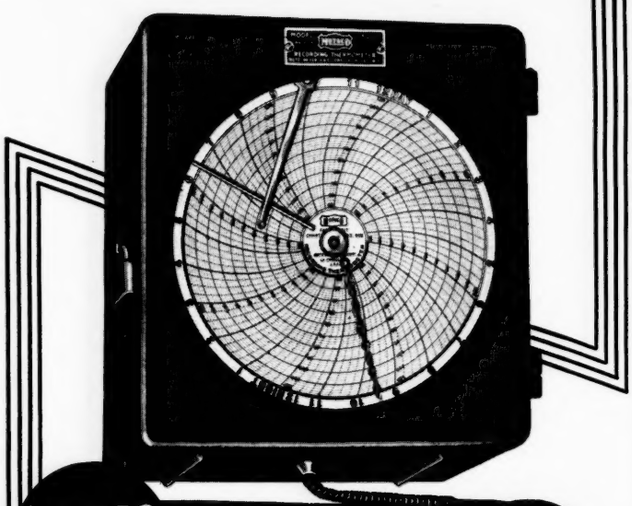
E. B. BADGER & SONS CO.

75 Pitts Street, Boston, Mass.

Agents in Principal Cities

BADGER EXPANSION JOINTS

The MOTOCO RECORDING THERMOMETER
MODEL 500
SIX INCH CHART



$27.50 LIST PRICE

A MOTOMETER PRODUCT

THE Model "500" Motoco Recording Thermometer is a valuable addition to any equipment requiring temperature regulation. Its easy-reading, six-inch chart provides a continual, accurate temperature record and permits you to obtain greatest efficiency and economy in operation.

The Model "500" Motoco Recording Thermometer is the result of many years of manufacturing precision Temperature Indicating and Recording Instruments. The solid, liquid-filled movement is of exclusive Moto Meter design, sturdily constructed, and will render many years of valuable service.

The Model "500" is manufactured in three types; i.e., wall mounting with flexible capillary tubing, portable with strap handle and flexible capillary tubing, and portable self-contained.

Write for detailed information. We shall be pleased to quote on your requirements.

MOTOMETER GAUGE and EQUIPMENT CORPORATION
LA CROSSE, WISCONSIN U. S. A.

NEW CATALOGS

Unless otherwise indicated the publishers of catalogs will supply copies on request without charge.

Carbondale Machine Corp., Unit of Worthington Pump and Machinery Corp., Harrison, N. J. A six-page, standard size bulletin No. 1107, describing the company's vertical duplex refrigeration compressors, size 5 x 5 in., and smaller. Illustrations include a cross-section of the compressor, details of the Feather valve; specifications, dimensions, and other information are included.

C. A. Dunham Co., 450 East Ohio St., Chicago. A new and greatly enlarged edition of The Dunham Hand Book. Designated as No. 514, the publication contains 464 pages, is bound in a durable, flexible cover. Page size, 4 in. x 6¾ in. The book fulfills several functions, being a complete catalog of the company's products in addition to and complementing a large amount of explanatory material relating to various phases of steam heating. Forty-five pages are devoted to engineering data, which include calculating radiator surface, information on boiler capacity, chimneys, piping design, drafting room symbols, capacity of pipe coils, properties of steam, and a nomographic chart with instructions for keeping records of daily steam consumption, and an explanation of the degree-day method of comparing heating results. The first part of the book is devoted to the development of steam heating and the development of heat control, with particular reference to the company's differential heating system. This system is described in considerable detail, both in text and with graphs and drawings, and 91 pages are devoted to the process of designing or laying out a differential installation, including information on products used and their relationship to the installation as a whole. Twelve pages are devoted to the application of the differential system to ventilating and air conditioning, and as many more to its application to unit ventilators. Similar information is given for the company's low pressure, steam heating systems, followed by detailed descriptions, illustrations, and data relating to numerous other products of this company. Although frankly a publication devoted to one manufacturer's products, nevertheless it contains so much information and data needed frequently in engineering offices that it can be considered an important addition to the libraries of such offices.

Lewis Air Conditioners, Inc., Minneapolis, Minn An eight-page, standard size folder in color entitled Lewis Air Conditioning. Describes and illustrates and gives engineering data on heating and humidifying room units, central plant conditioners of the indirect type, and others of the warm air conversion unit type.

The Ohio Electric Mfg. Co., 5900 Maurice Ave., Cleveland. Sheets 4-7, inclusive, of Bulletin 212-B showing dimensions of the various types of fractional size motors offered in standard frames. Also Sheets 10-14, inclusive, of Bulletin 211-A giving dimensions of popular special designs and identifying them with standard frames.

Owens-Illinois Glass Co., Industrial Materials Div., Newark, Ohio, has published a standard size, 12-page bulletin in color, loose leaf punched, describing and illustrating the Dustop replacement type air filter. Also recently published are Bulletin 200-1 describing the replacement type filter for "L" type frames, four pages; also Bulletin 200-2, a four-page folder featuring the replacement type filter in the space saving type "V" frame.

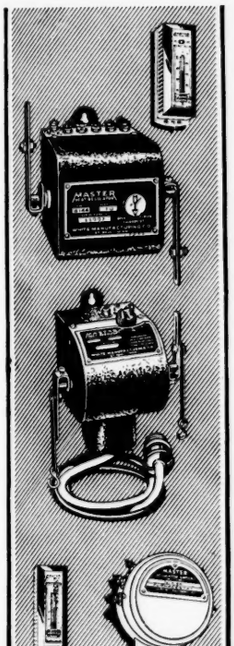
The Patterson-Kelley Co., Inc., East Stroudsburg, Pa. A standard size, 22-page catalog entitled Patterson Hot Water Service Heaters. Illustrates and describes various types of the company's hot water service and storage heaters, and in addition presents engineering data for estimating hot water consumption for various types of buildings.

Ross Heater & Mfg. Co., Inc., 1407 West Ave., Buffalo, N. Y. A fuel oil heater catalog, form 1046. Gives description, drawings, dimensional and capacity tables for selecting these types of heaters for any particular service.

The experience of a pioneer

goes into the manufacture of every MASTER Heat Regulator —whether made for a mansion or a bungalow

In the progress of heat regulation, and the crossing of new frontiers from year to year, you can save yourself many costly mistakes by tying up with a concern that has been in the game from its earliest development — White Manufacturing Company.



Type B-144
4 Position

The last word in a de luxe heat regulator. It features the Master Thermo-Wafer, platinum - iridium contacts, 4-watt non-inductive starting switch, 4 position control and attractive thermostat. You can offer a fastidious customer no greater value.

Type B-22
2 Position

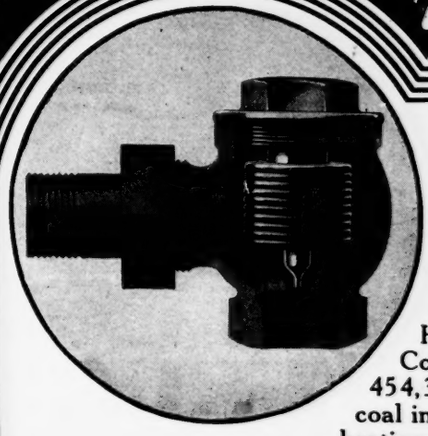
— is the heat regulator for the moderate-salaried home owner. Noiseless, accurate, easy to install, long-lived, listed as standard by Underwriters' Laboratories—a real MASTER Heat Regulator for as low as $13.50

Write for particulars TODAY

MASTER HEAT REGULATOR

WHITE MANUFACTURING CO.
2304 UNIVERSITY AVE., ST. PAUL, MINN.

Sarco Adapters Saved $328.00 in one year



The Phoenix Insurance Co., Hartford, Conn., burned 454,360 lbs. of coal in one year for heating. Then Sarco Adapters were installed in their old radiator traps, and they burned only 372,305 lbs. of coal the following year.

Not only did Sarco Adapters save approximately 25% of their coal, but their Chief Engineer reports that their heating efficiency was increased 40%.

Sarco Adapters are guaranteed to make old radiator traps of any make equal to new in steam saving.

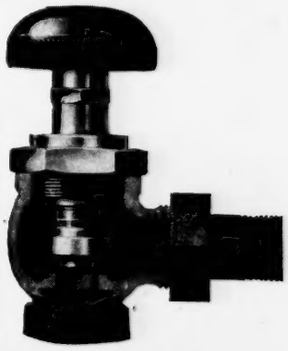
Sarco Adapters

make radiators heat evenly and rapidly so that ample heat will be furnished with greatly reduced steam pressure.

They consist of a cap and a motor element and can be easily fitted into any trap without disturbing the pipe connections. Consequently they not only save money over the cost of buying new traps, but also cut installation cost in half.

Inlet Valves, too, can be modernized with Sarco Packless Valve Bonnets.

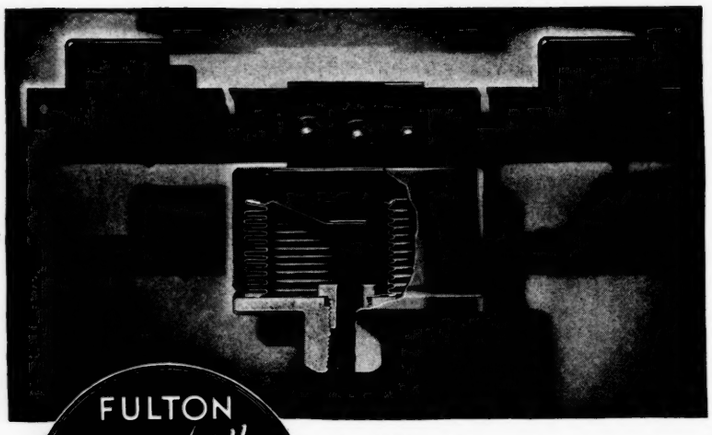
Write for Catalog P-111.



See our Exhibit at Booth 144, International Heating and Ventilating Exposition, Amphitheatre, Chicago, Ill., January 27th to 31st, 1936.

SARCO CO., INC.
183 Madison Ave., New York, N. Y.
Branches in Principal Cities
Sarco Canada Limited, Federal Bldg., Toronto, Ont., Canada.

Now is the time to look for business
IN DAMPER REGULATION



FULTON *Sylphon* FOR TEMPERATURE CONTROL

No. 600—(illustrated) Household Steam Heaters

No. 610—For Low Pressure Steam Boilers

No. 620—For Hot Water Boilers and Tank Heaters

FULTON SYLPHON CO.
KNOXVILLE, TENN., U.S.A.

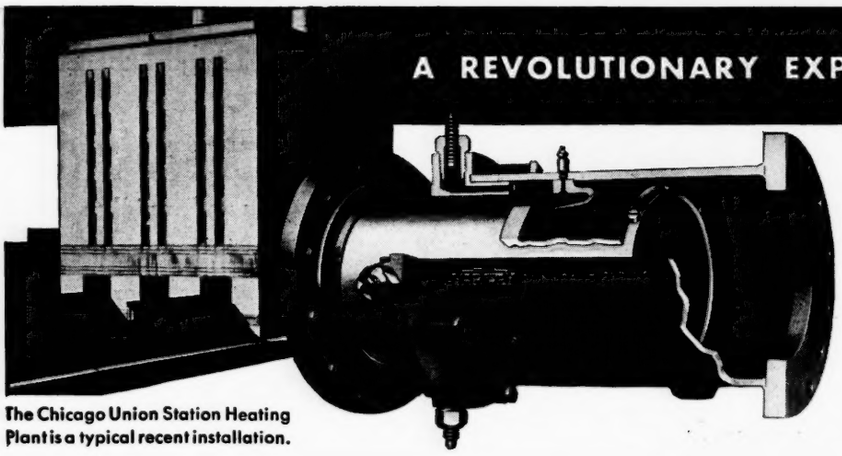
Representatives in All Principal Cities in U. S. A. and in Montreal, Canada and London, England.

Now—with real winter weather demanding the best that's in every heating system—go after the thousands of boilers that have inferior damper regulators, regulators that are out of order, or no damper control at all.

It's a broad waiting field. Let Fulton Sylphon help you cash in with the Sylphon All-Metal Damper Regulator that sells faster because it is the recognized leader—the regulator that is standard equipment on leading makes of heaters—the regulator with a record of quality and performance that is without equal.

The moderate prices—liberal discounts—free literature imprinted with your name, and suggestions for a planned local sales drive—will interest you. Write for Bulletin XH-526.

A REVOLUTIONARY EXPANSION JOINT DESIGN



The Chicago Union Station Heating Plant is a typical recent installation.

YARWAY GUN-PAKT

It is packed under full steam pressure. By the turn of a wrench, integral pressure guns force a special semi-plastic packing into the stuffing box.

Welded Steel Construction. Alemite lubricated cylinder-guided sleeve. Made also in conventional gland-pakt types. Write for Bulletin EJ-1904.

YARNALL-WARING COMPANY
104 Mermaid Ave. PHILADELPHIA

TITUSVILLE FIREBOX BOILERS

THERE'S ONE FOR EVERY HEATING JOB

HIGH EFFICIENCY LOW MAINTENANCE

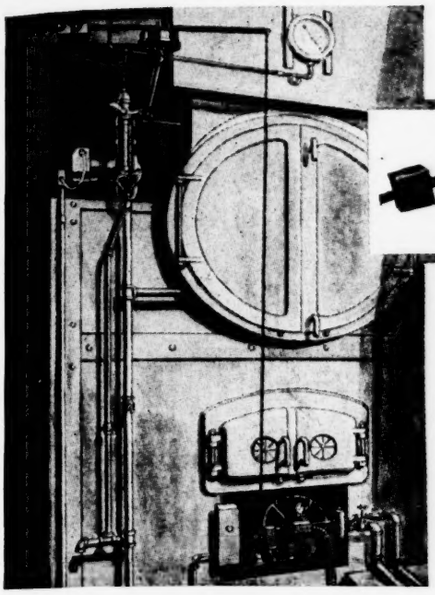
Do the job *More Economically* with one of the Titusville Family of *Firebox Type Boilers*—the efficient solution to every heating problem. Write for Bulletin 9090-AHV.

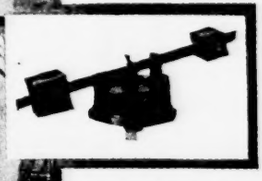
THE TITUSVILLE IRON WORKS COMPANY
Division of Struthers Wells-Titusville Corporation
TITUSVILLE, PA.

Heating and Ventilating Degree-Day Handbook

This book tells what the degree-day is and how it is used. Contains tables of average degree-days by months for 1000 cities, fuel charts and degree-day maps. 56 pages. Price $1.50.

HEATING AND VENTILATING
148 Lafayette St., New York





METAPHRAM
Type C2
for low pressure or vacuum systems—oil or coal fired.

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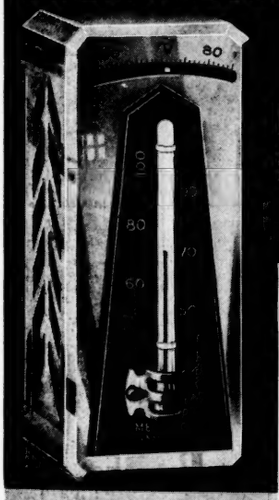
METAPHRAM Gradual Control
covers the entire range of domestic hot water and low pressure boilers and tank heaters, either gas, oil or coal fired.
Full stock carried in New York, 210 E. 45th St.
Descriptive Bulletins on Request

NATIONAL REGULATOR CO.
2309 KNOX AVENUE CHICAGO

"WE USE CHACE Thermostatic BIMETAL Exclusively IN THE MERCOID SENSATHERM"

THE MERCOID CORPORATION



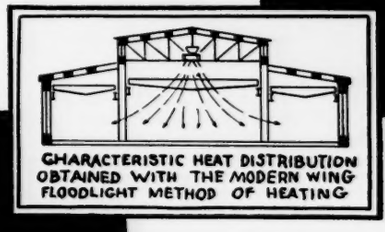
CHACE THERMOSTATIC BIMETAL
"It Bends with the Heat"

With the slightest change in temperature, highly sensitive Chace Thermostatic Bimetal units move to make or break electric contact, thus automatically setting to action such other mechanism as results in room temperatures exactly to our liking.

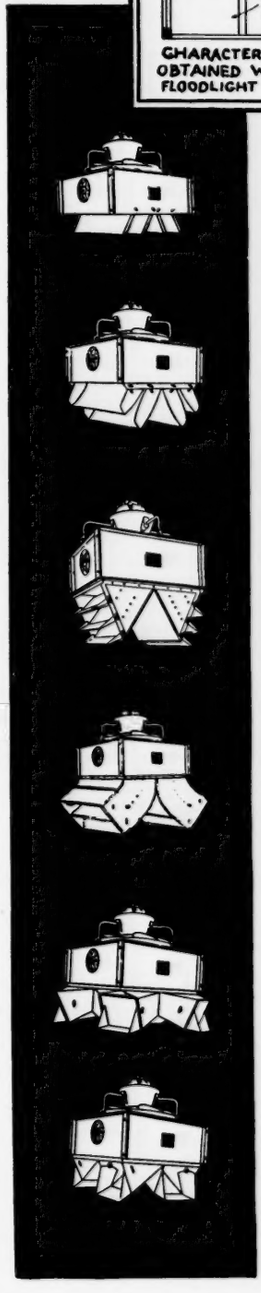
If control of temperature is your problem or if you wish to have temperature changes perform automatic duties we suggest that you investigate Chace Thermostatic Bimetal. ***Sold in Sheets, Strips or Formed to Specifications.***

W. M. CHACE VALVE CO.
1606 Beard Avenue . . . Detroit Mich

The Most Efficient Solution to Building Heating Problems



CHARACTERISTIC HEAT DISTRIBUTION OBTAINED WITH THE MODERN WING FLOODLIGHT METHOD OF HEATING



Keen competition is, today, turning the attention of industrial executives and commercial building owners more and more to the problem of reducing maintenance costs to a minimum.

Heating systems and methods are not being overlooked, for informed and progressive managements are demanding: the heating system that will not interfere with production equipment or take up valuable floor space—that delivers a uniform invigorating temperature over the entire working area—that eliminates the concentration of useless (wasted) heat in the upper areas of the room or building.

The Wing Floodlight Method is the ONE system that is designed to overcome these vital deficiencies of the ordinary methods of heating.

It will pay you to recommend and specify this advanced method of heating—write today for complete information.

L. J. Wing Mfg. Co.
158 West 14th Street
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and everywhere

WING *Floodlight* HEATING

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HEATING AND COOLING SURFACE

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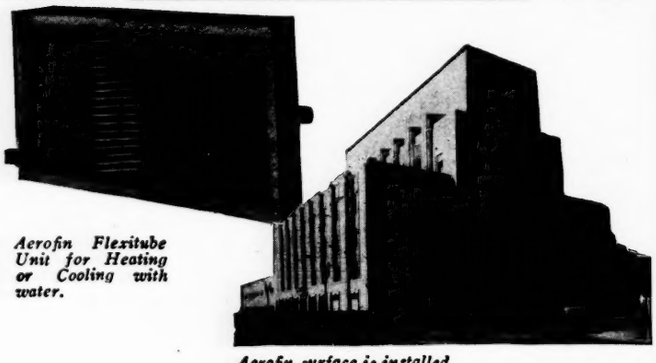
Aerofin Standardized Light Weight Fan System heat exchange surface is the first choice of architects, engineers and building owners for Heating or Cooling because of its proved superiority. Progressive heating and cooling contractors install it because it gives complete satisfaction.

Aerofin is years in advance of ordinary heating and cooling surface because of its exclusive features. It is available in aluminum, copper or other special metals. Whatever you have wished for in a fan system surface you will find in Aerofin.

The home office in Newark or any of our branch offices will gladly send complete descriptive literature or render prompt, personal and efficient technical cooperation. Simply write to the address below.



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Aerofin surface is installed in the Los Angeles Times Building. Gordon B. Kaufmann, Architect. P. J. Walker Company, Building Contractors. Carrier Engineering Corporation, Air Conditioning Contractors.

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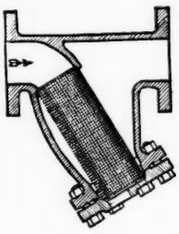
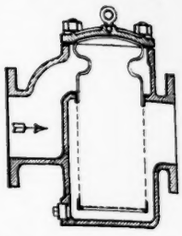


- STEAM
- WATER
- OIL
- GAS
- AIR SERVICE



PROGRESSIVE engineers know that the modern way to protect pressure regulators, meters, traps, valves and other equipment with moving parts against undue wear and costly interruptions in service, is to install dependable strainers to remove the scale, joint compound, and solid impurities commonly present in all lines.

Considering their moderate cost, Davis Strainers represent one of the most profitable equipment investments that can be made in any plant.

- **ADVANTAGES**—A suitable strainer for every service —Long time record for reliability—Minimum maintenance cost—over size screens — excess area body passages—Minimum pressure drop—Utmost simplicity —Bronze, Iron or steel.

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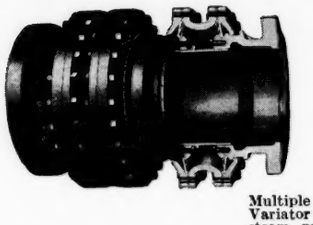
AUTOMATIC VALVE SPECIALISTS

ADSCO MULTIPLE DIAPHRAGM VARIATOR



Multiple Diaphragm Variator illustrated. For steam pressures to 400 lbs. and temperatures to 750° F.

ELIMINATES MANHOLES

dependability proved by 40 years of service

ADSCO Variators are packless expansion joints of the diaphragm type, specially designed for use in connection with underground steam lines. They eliminate all necessity for manholes and are recommended for use wherever manholes cannot be installed. The basic principle of ADSCO Variators has been in use for more than 40 years.

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Deals with the fundamentals of air conditioning. Particularly valuable for the engineer whose academic training dates before air conditioning was so generally accepted. 375 pages. Price, $4.00 a copy.

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HEATING & VENTILATING

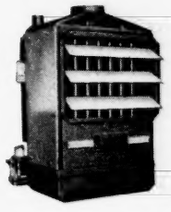
Book Service

148 Lafayette St. New York

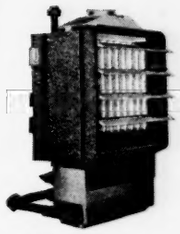
INSTALL MODERN HEATING EQUIPMENT

- These self-contained *gas-fired* heating units have many advantages over any other type of heater.
- Their streamlined heating tubes permit the greatest possible heat radiating area.
- They provide heat where you want it—uniform temperature automatically controlled.
- Since the heat is not conducted through pipes or ducts, there is no heat loss. Thus maximum fuel efficiency is obtained. Better than 80% efficiency, when vented, is very common.
- The ceiling and floor temperatures are the same. The heater is suspended from the ceiling and the heated air is forced downward by fan circulation, driving the cold air upward where it is heated.
- Cold spots and hot spots are thus eliminated.

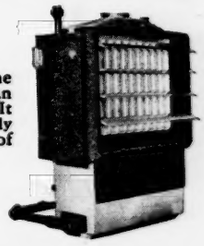
SC GAS UNIT HEATERS



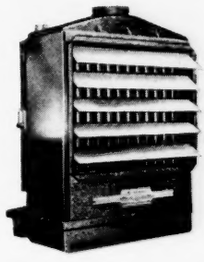
U-60-35model. Hourly input 60,000 B.T.U.



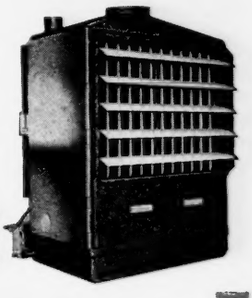
C-834 model. Hourly input 85,000 B.T.U.



C-1034 is one size larger than the C-834. It has an hourly B.T.U. input of 100,000.



U-125-35 model. It has an hourly B.T.U. input of 125,000. Also available in 100,000 B.T.U. input, with belt driven slow speed fan.



U-200-35 model. It has an hourly input of 200,000B.T.U.

- The units are self-contained. Their operation requires no water, oil, coal or manual attention. They operate automatically.
- They provide clean heat because they burn gas. All smoke, dust, ashes, etc., eliminated.
- Heat can be had immediately in one part of the building without having to heat up other areas.
- Install *modern* heating equipment. It reflects greater values to you.

SURFACE COMBUSTION CORPORATION

TOLEDO, OHIO

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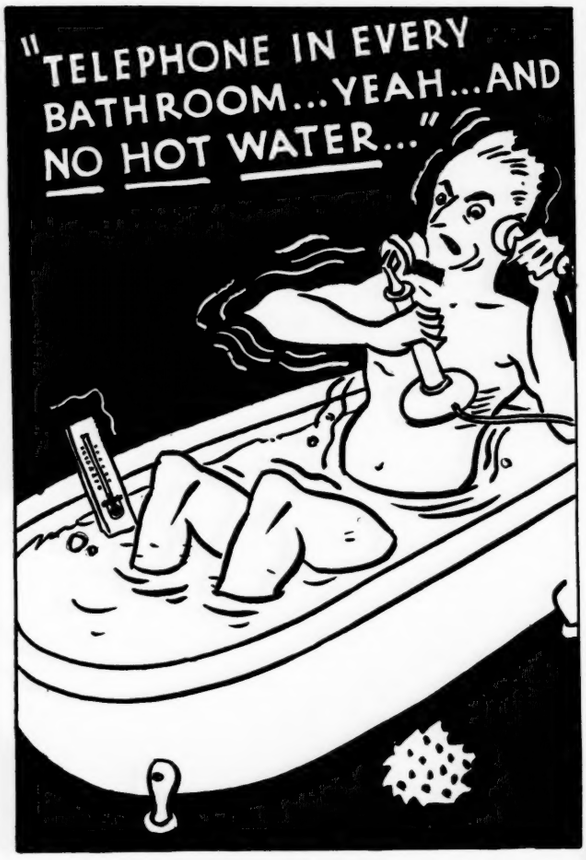

No hotel luxury takes the place of good clean hot water—and that means a Whitlock-Everdur Type K Heater

The hotel business is better—alert owners are quick to realize the necessity of keeping service up-to-date to attract guests their way.

Alert Engineers and Contractors are also quick to realize that Whitlock-Everdur Storage Heaters offer them something NEW and sound on which to base their chances for selling hotels, and other hot water users, on the advisability of revamping their water heating systems.

Remember there are TWO points:

FIRST it's a Whitlock Type K—the design that thousands of installations have proved successful; SECOND, its shell of solid Everdur can never rust, so (a) it supplies Clean Hot Water, and (b) the heater will never have to be replaced again.

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In Canada address Darling Bros., 120 Prince St., Montreal.

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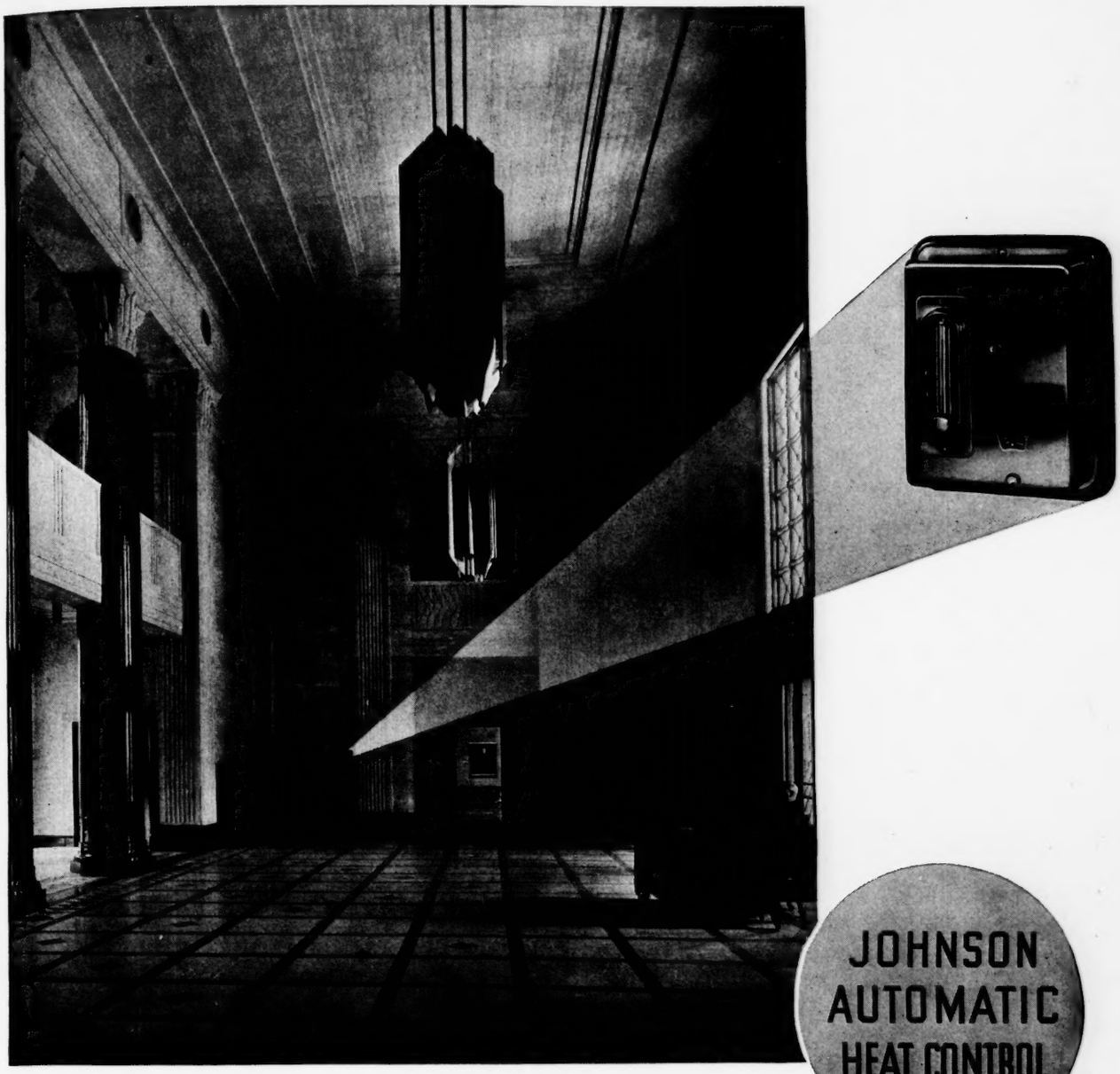

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JOSLYN MEMORIAL, *Omaha, Nebraska,* JOHN McDONALD & ALAN McDONALD, *architects;*
Engineering Service Company, mechanical engineers, Omaha, Nebraska

For Protection and Economy!

ECONOMY, COMFORT, CONVENIENCE! Those are the results usually sought when automatic temperature control apparatus is considered. Incidentally, those are the results attained when the regulation equipment is JOHNSON. But beyond that, there are many instances where accurate dependable control of temperature and humidity is essential for *protection*. Museums, art galleries, and certain industrial processes are examples of such applications, where exhibits and products must be protected against insufficient or excessive temperatures and humidities. . . . In the beautiful Joslyn Memorial, a gallery of valuable art treasures, some 120 JOHNSON *dual* thermostats operate JOHNSON valves on 244 direct radiators. A comfortable temperature during occupancy periods and a safe, reduced temperature at other times! Humidifying and ventilating are JOHNSON controlled, as well.

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